# THE MODEL ENGINEER

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# The MODEL ENGINEER

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16TH NOVEMBER 1950 VOL. 103 NO. 2582



# SMOKE RINGS

### Our Cover Picture

● THE PHOTOGRAPH from which we have prepared this week's cover has been sent to us by Mr. Dan Hollings, hon. secretary of the West Riding Small Locomotive Society, who took it on the society's recently-completed track at Blackgates. It shows Mr. A. Balmforth with his modified "Hall" class locomotive and a well-loaded train entering the station. The concrete arch at lower left was the last of the circuit to be cast; it carries a bronze plaque reading "C. E. Taylor, June, 1948," a tribute to the member who was the leading light in the construction of the track.

Buried in the concrete is a casket containing a copy of the society's rules, a current list of members and the names of the society's founder-members, together with a letter addressed to anyone who, some day in, let us hope, the very distant future, may demolish the work. This seems to be quite a novel idea, so far as miniature locomotive tracks are concerned, and we can only make a guess as to the contents of the letter. We have little doubt, however, that the message is an appropriate one.

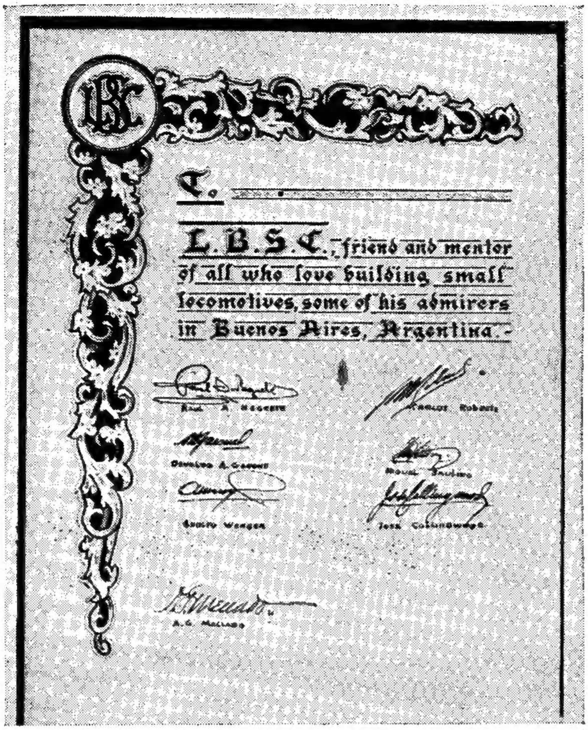
Incidentally, we wonder why Mr. Balmforth has mounted safety-valves on top of the firebox of his engine? Such an arrangement seems incongruous on a G.W.R. boiler of this type, and we do not know of any other instance of it.

### First Post-war Exhibition at Norwich

● THE NORWICH and District Society of Model Engineers collected together a most impressive variety of models to mark the resumption of that periodical series of exhibitions which won such esteem for the society before the war. This first post-war exhibition by the society must have done a great deal towards stimulating local interest in model engineering as a hobby; about 300 separate exhibits covered practically every phase of interest, every section being a strong one. The loan section, which was large enough to account for about half the entire show, contained an unusual variety of old-time models of all sorts, and demonstrated clearly that here is an almost inexhaustible field for exploration by anyone who may be looking for something to make. An interesting feature was a section for exhibits made by schoolchildren; there were not many of them but they ranged from a railway signal to a large model of a harbour, complete with a considerable quantity of shipping, to the scale of 100 ft. to 1 in. and displaying keen powers of observation on the part of its builder. But perhaps the most ambitious effort in this section was a chassis for "L.B.S.C.'s" *Petrolea* 2-4-0 G.E. locomotive built strictly according to the well-known "words and music" by a lad of 16! Apart from some not altogether unexpected signs of chatter on the treads of

the wheels, we could find nothing wrong with it. We wish this youthful enthusiast all possible luck with the completion of his *Petrolea* and any other locomotives he may build in the future.

Norwich has been, for many years, a stronghold of model engineering, but during the war the N. & D.S.M.E. suffered a grievous set-back when its headquarters were destroyed by enemy action. That, however, did not quench the enthusiasm, energy and enterprise of the members, who are clearly determined that Norwich shall recover its former position as one of the leading centres of our hobby; no more convincing evidence of this could be found than this first post-war exhibition, and we congratulate everybody concerned in it.


To ______

L.B.S.C. friend and mentor of all who love building small locomotives, some of his admirers in Buenos Aires, Argentina.

## The Passing of the "Portable"

● THE ARTICLE by B.C.J. in our issue for October 19th has aroused considerable interest, and many readers have written us letters on the subject. We hope to find space for some of these letters in our "Correspondence" columns. In the meantime, we would refer to and quote from one received from Mr. W. W. Martin, of Maidstone, who suggests that B.C.J. is "a little premature in his funeral oration over this type of engine." We rather think that what B.C.J. had in mind was the fact that, so far as is known, steam portable engines are no longer being built, several years having now elapsed since the last one was turned out, and the probability is that no more will be built. But we cannot be sure of this yet, of course.

Mr. Martin, however, goes on: "Although the portable is now very rarely seen on farms, many are still to be found at work in sawmills up and down the country; in fact, I know of a Foster 10 n.h.p., built in 1942, at use at a sawmill at Hawkhurst, Kent, and a very large Robey portable, built about the same time, working at a mill adjoining Forest Row railway station.

"Two large Garrett overtype engines are in daily use at Messrs. Turner's mills at Sheffield Park and Frant, Sussex, both generating electric power. Only a few months ago I saw a large Robey of about 14 n.h.p. with two high-pressure cylinders; it was mounted on a lorry proceeding down the London-Ashford road and appeared to be brand new. On reflection, I find I know of some twenty portable engines in daily use, ages varying from five to sixty years. No, B.C.J., the portable is not dead yet, and as a sawmill engine where fuel is cheap, it is likely to survive for many years yet."

Regarding the use of steam as a source of power, we take the view that it will never be entirely superseded; it is such a simple element to use that future engineers are certain to study new methods of generating it, and although all kinds of steam engines that we know will be abandoned, they are likely to be superseded by new forms combined with new types of steam-generators.

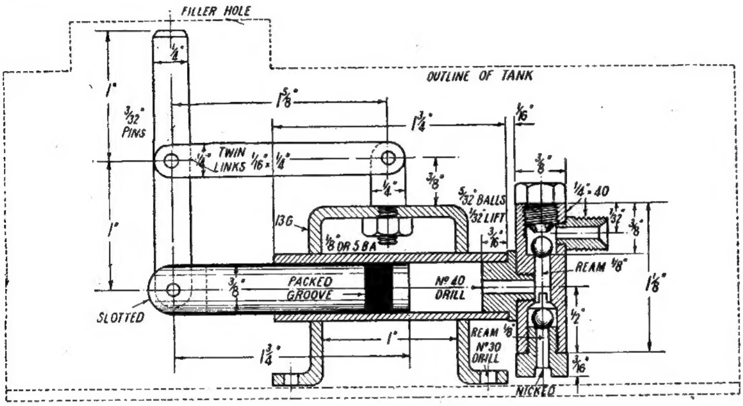
## A Nice Tribute

● WE REPRODUCE herewith a photograph of an entirely unsolicited testimonial which has been received by our ever-popular contributor "L.B.S.C." whose weekly instructions have been the means of making the building of "live steam" miniature locomotives possible for enthusiastic readers in almost every country of the world. We cannot recall that any contributor to THE MODEL ENGINEER, excepting its founder, the late Percival Marshall himself, has previously been the recipient of a spontaneous tribute of this kind, and we think that it is fitting that "L.B.S.C." should be the first to be so distinguished. For more than twenty-five years his writings have been followed with avidity wherever there is any interest in small locomotives, and his pseudonym has become a household word to many thousands of followers. This is all the more remarkable in view of the fact that, personally, he is known to so few. But the truth is that his teachings—no other word seems to fit—have brought pleasure and recreation within reach of a very large number of potential craftsmen who might otherwise have never known their own capabilities; he has always made certain that his advice was founded on actual practical experience and, if explicitly followed, would lead to nothing but successful results; in this way, he has won the respect and confidence of his followers and baffled those who disagree with his methods.

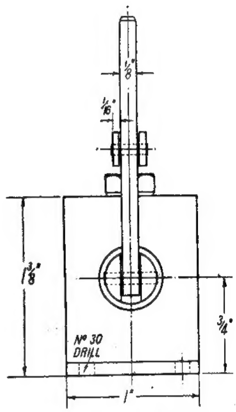
# "L.B.S.C.'s" Beginners' Corner

## How to Test "Tich's" Boiler

BEFORE putting any fittings on the boiler of *Tich*, it will be necessary to see if the workmanship is good enough to stand the working pressure. Just to cheer up any beginner who feels a little uneasy, I might add that the only failures that have come to my notice, in boilers of this kind, have been nothing worse than the sprouting of a few Welsh vegetables; and small leaks are easily stopped. Even if a plate or seam failed, there isn't the slightest danger of an explosion, as the failure would immediately release the pressure of water; you might hear a faint click, but that would be all. In the case of a boiler giving way under steam pressure, it is the sudden expansion of the steam, from bursting pressure down to atmospheric pressure, that causes the bang; and if the boiler stands the water pressure test all right—as it will, if the instructions have been followed—there won't be any fear of *that* happening!




Section of hand pump




Lever end of pump

### Hand Pump Construction

The "ingredients" needed for the test, are as follows: a pump, for creating pressure; a gauge to register it; a couple of adapters for connecting up the pump and the gauge to the boiler, and plugs for the holes not being used. The hand pump, which I specify for emergency use, and which will be installed in one of the side tanks, will do fine; so I will describe how to make it, right away. The gauge should read to about 250 lb. per sq. in., or over; I use a pressure-gauge of the kind fitted to full-sized engines. This has a central hand and reads to 360 lb. The same adapters used for the "pinhole" test can be once more pressed into service, but you'll need proper screwed metal plugs, as wooden ones would blow out under the test pressure. They can be made by following the method described for blind nipples, but need not be drilled up and tapped, as only the outside threads are needed. Odd scraps of round rod make nobby plugs; slot the heads with a hack-saw, and put them in with a screwdriver instead of a spanner. In these times of mounting prices, it behoves us not to waste anything that can be made use of!

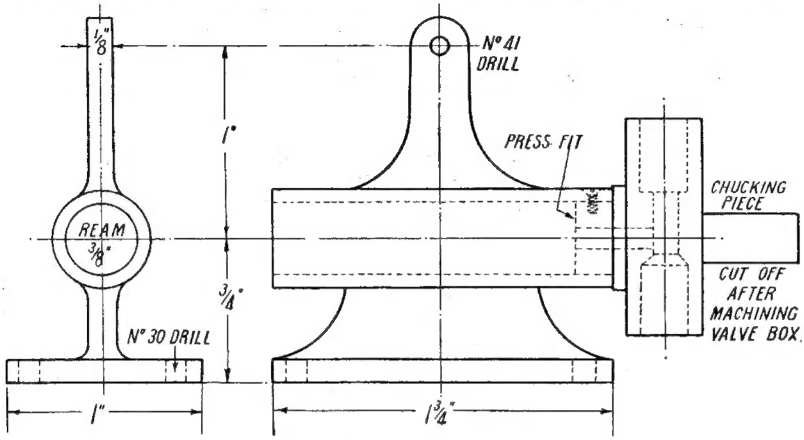
### Pump Stand and Barrel

The pump can be made without castings, or a cast stand, barrel, and valve box can be used; please your own fancy. In the former case, a piece of 13-gauge (3/32 in.) brass or copper will be needed, 1 in. wide and approximately 4¼ in. long. This is bent to the shape of one of the old broad gauge bridge rails of the Brunel era on the Great Western. The diagrams show how to bend it easily in the bench vice. Mark out the strip as shown; then grip it in the bench vice with the second line just showing above the jaws—this will be one of the top bends—and bend over at right angles, by aid of a hammer used judiciously. Now put a bit of steel bar, 1 in. wide, in the angle thus formed; grip in the vice as shown, and make the second bend. Now put the forming block at the place where the bends for the lugs or feet are needed, and grip the embryo stand in the bench vice, upside down, with the two bits which will form the feet, projecting above the jaws. Knock these outwards and downwards until they are flat on top of the vice jaws, and Bob's your uncle.

On the vertical centre-line of each side, at ¾ in. from the bottom, drill a No. 30 hole. If beginners centre-pop the first side, set the needle of a scribing block to the pop mark, then turn the stand around and make a scratch across the vertical

centre-line without shifting the scriber needle, they will be sure of getting pop No. 2 in the right place, and the two drill-holes will be exactly level. Open out both of them with a $\frac{3}{8}$ in. drill. Right in the middle of the top, drill a No. 30 hole; then drill two similar holes in each foot, for the holding-down screws. File off any burrs.

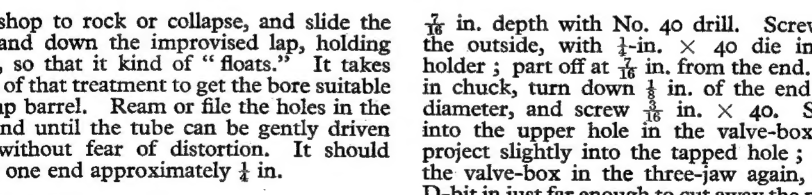
Part off at $\frac{3}{16}$ in. behind the shoulder. Reverse in chuck, and turn down $\frac{1}{8}$ in. of the other end to $\frac{3}{16}$ in. diameter; screw $\frac{3}{16}$ in. × 40. This forms the connecting piece between pump barrel and valve box. Part off a piece of $\frac{3}{8}$-in. brass rod to a full $1\frac{1}{8}$ in. length; chuck in three-jaw, centre, and drill right through with No. 34 drill. Open




*Alternative cast pump body*

The best material for the barrel, is a bit of $\frac{7}{16}$-in. brass treblet tube, squared off at each end in the lathe, to a length of $1\frac{3}{4}$ in. For beginners' special benefit I might repeat that treblet tube has been three times through the drawplate—hence its name—and will be smooth and true enough inside, to be suitable for a pump barrel, or even a small steam cylinder, without any further treatment. If this particular material isn't available, use ordinary tube. Square off to length, as above; then put a bit of round wood in the three-jaw, with sufficient emery-cloth or similar abrasive, wound around it to make it fit the tube loosely. Put the bit of tube over it, run the lathe as fast as you can without causing

out and bottom one end to $\frac{3}{8}$ in. depth, with 7/32-in. drill and D-bit, same as for the eccentric-driven pump, and tap $\frac{1}{4}$ in. × 40. Slightly countersink the end and face off any burr. Repeat operations on the other end, except that the hole is left as drilled, the D-bit not being needed; instead, nick the small hole as shown. At $\frac{5}{8}$ in. from the D-bitted end, drill a 5/32-in. hole in the side of the valve box, piercing the central passage, and tap it $\frac{3}{16}$ in. × 40. Diametrically opposite, at 7/32 in. from the D-bitted end, drill another 5/32 in. hole, and tap $\frac{3}{16}$ in. × 40; in this, fit a $\frac{1}{4}$-in. × 40 union screw. Chuck a piece of $\frac{1}{4}$-in. brass rod in three-jaw; face the end, centre deeply, and drill down about




*Extension pump handle*

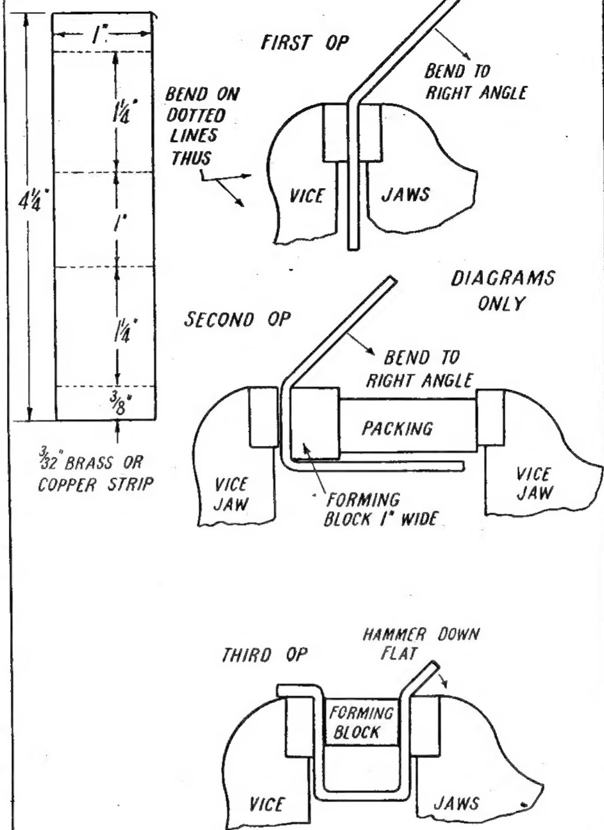
the workshop to rock or collapse, and slide the tube up and down the improvised lap, holding it loosely, so that it kind of "floats." It takes very little of that treatment to get the bore suitable for a pump barrel. Ream or file the holes in the pump stand until the tube can be gently driven through without fear of distortion. It should project at one end approximately $\frac{1}{4}$ in.

## Valve Box

Chuck a bit of $\frac{7}{16}$-in. round brass rod in the three-jaw, face the end, centre, and drill down to about $\frac{1}{2}$ in. depth with No. 40 drill. Turn down $\frac{3}{16}$ in. of the end, to a tight fit in the pump barrel.

$\frac{7}{16}$ in. depth with No. 40 drill. Screw $\frac{1}{4}$ in. of the outside, with $\frac{1}{4}$-in. × 40 die in tailstock holder; part off at $\frac{7}{16}$ in. from the end. Reverse in chuck, turn down $\frac{1}{8}$ in. of the end to $\frac{3}{16}$ in. diameter, and screw $\frac{3}{16}$ in. × 40. Screw this into the upper hole in the valve-box. It will project slightly into the tapped hole; so chuck the valve-box in the three-jaw again, enter the D-bit in just far enough to cut away the projection, and follow up with the $\frac{1}{4}$-in. × 40 tap. Put a $\frac{1}{8}$-in. parallel reamer through the remnants of the No. 34 hole at the bottom.

Press the spigot of the connecting piece into the end of the pump barrel which projects




*How to bend pump stand*

farthest from the stand; screw the valve box on to the screwed pip, and set it so that the valve-box is vertical, with the union screw at the top. Then solder over the two screwed joints, the place where the connecting piece joins the barrel, and the places where the barrel passes through the stand. Beginners may want to know why the connecting piece and the union screw are not made press fits in the valve-box, and the whole bag of tricks silver-soldered. The reason is, that if you make the barrel red hot, it will go soft, and probably distort a little; in which case it won't be suitable for a pump barrel any more. Anybody who so desires, can silver-solder the connecting-piece and the union screw into the valve-box, in which case there would be no need to screw them; but the connecting-piece would still have to be pressed into the barrel and soft-soldered, and the barrel soldered around the holes in the stand, which makes the job equivalent to taking two bites at a cherry.

The valve-balls are fitted in the same way as those on the eccentric-driven pump, so that job can soon be disposed of. Drop a 5/32 in. rustless steel ball into the D-bitted end of the valve-box, and seat it with a hammer-blow via a bit of brass rod, as described for the other pump. Gauge the depth as before; chuck a bit of 5/16-in. or 3/8-in. hexagon brass rod in three-jaw, and turn down to ¼ in. diameter, a length equal to the depth just measured. Screw ¼ in. × 40, slightly cone the end as shown in the illustration, and skim 1/32 in. off the face, to allow the ball that amount of lift. Part off a full ⅛ in. from the shoulder; reverse in chuck, holding in a tapped bush, and chamfer the corners of the hexagon, then screw the plug home.

Turn the doings upside down, and drop another ball in the nicked end, taking the depth as before. Chuck the 5/16-in. or 3/8-in. rod again, turning down a length equal to the gauged depth, to ¼ in. diameter, and screwing ¼ in. × 40. Centre, and drill down about ½ in. depth with No. 34 drill; ream ⅛ in., then take a skim off the end, to get it perfectly true. Part off at 3/16 in. from the shoulder; reverse in chuck, and chamfer the corners of the hexagon. File a nick about 1/16 in. wide, right across the end of the hole. Stand the gadget on something solid, put a 5/32-in. rustless steel ball in the faced end, give it a crack, with a bit of soft metal between ball and hammer, to seat it, then screw home as shown.

## Ram, Lever and Links

If you have a piece of ⅜-in. round rustless steel or bronze, that will slide easily in the pump barrel, no "turning to fit" will be required. The overall length is a bare 2 in. Chuck in three-jaw, face the end, and turn a groove 3/16 in. wide and ⅛ in. deep, at ⅛ in. from the end. Reverse in chuck, and round off the other end a little. At 1⅞ in. from the grooved end, drill a No. 43 hole right across the diameter; then cut a ⅛-in. slot in it, ½ in. deep, by the same means fully described for the eccentric-driven pump.

The lever is merely a 2⅛-in. length of ⅛-in. × ¼ in. hard brass or nickel-bronze (German silver) with one end rounded off, and a No. 41 hole drilled through it. At 1 in. above this hole, drill another similar. Slightly bevel the top, as shown.

The links are two pieces of similar metal, ¼ in. wide and 1/16 in. thick, and a bare 2 in. long. Make two centre-pops 1⅝ in. apart, clamp the bits together, drill through both at once with No. 43 drill, and round off the ends. There is no need to worry about Inspector Meticulous when finishing off these jobs, as he can't see inside the tank, and the pump would work just as well if the ends of the lever and links were left absolutely rough-cut; but you don't want to

leave them like that—there is a medium in all things! However, life is short, and there is no need to waste it by spending hours on "spit-and-polish," when nobody sees the result, and it doesn't improve the working of the engine by one-millionth per cent!

To make the anchor lug, chuck a bit of $\frac{1}{8}$ in. × $\frac{1}{4}$ in. rod in four-jaw, set to run truly, turn down $\frac{5}{16}$ in. of the end to $\frac{1}{8}$ in. diameter, and screw $\frac{1}{8}$ in. or 5 B.A. Part off at a full $\frac{1}{2}$ in. from the shoulder; drill a No. 41 hole through, at $\frac{3}{8}$ in. from the shoulder, and round off the end.

### How to Assemble

Put a link each side of the middle hole in the lever, and drive a bit of 3/32-in. rustless steel or hard bronze wire through the lot, leaving just a weeny bit sticking out each side, which may be slightly riveted over. Put the anchor lug between the links at the other end, and ditto repeato the pinning. Put the bottom of the lever in the slot in the ram, and pin that likewise. The links should hug the lever and the anchor lug like a teddy bear, so that the lever doesn't flop about sideways when erected. Pack the groove with a few turns of hydraulic packing, which can be obtained by unravelling a short bit of the stuff used for the glands of full-sized water pumps. If this is not available, graphited yarn can be used. Don't forget that the packing doesn't need to be so confoundedly tight that there is a risk of bending the lever when operating; all it needs, is to seal any tiny leak between ram and barrel. As the pump is "drowned" in the tank when in place on the engine, a small whimper doesn't make the slightest difference to the working, and the pump is only for emergency use, anyway.

Insert the ram into the pump barrel, prodding in the packing in the same way as described for the engine cylinders. Put the screwed end of the anchor lug through the hole in the top of the stand, and secure it with a brass nut underneath, as shown in the illustration; the job is then completed.

### Variation for Cast Pump

If using castings for the pump stand and body, and the valve-box, there is not much difference in the machining work. The body, or barrel and stand, will be all in one piece, with the anchor lug on top. Valve-box and connecting piece will be combined in a separate casting. First of all, smooth off the base of the stand, and the sides of the anchor lug with a file; drill the holes as shown. The casting can then be mounted on an angle-plate, as described for cylinders, and fixed by four $\frac{1}{8}$-in. bolts through the holes in the base, or clamped down by a couple of toolmaker's cramps, just as you fancy. Set the barrel to run truly; face the end, centre, drill right through with 23/64-in. drill, and follow with a $\frac{3}{8}$-in. parallel reamer. If this end is used for attachment of valve-box, there is no need to set up for machining the other end in which the ram will fit; it may either be left as it is, or smoothed with a file.

Chuck the valve box by one end, set the other end to run truly, and proceed exactly as described for the valve-box made from rod material. When the D-bitted end is finished, the casting won't run truly enough to do the other end, if merely reversed in chuck; so chuck any odd bit of metal above $\frac{3}{8}$ in. diameter, turn down about $\frac{3}{16}$ in. length to $\frac{1}{4}$ in. diameter, screw $\frac{1}{4}$ in. × 40, and screw the tapped end of the valve box on to it. It will then run truly, and the other end can be opened out, drilled, and tapped as described above.

Chuck the casting in the three-jaw by the chucking-piece on the back and turn the boss which forms the connecting-piece, to a tight fit in the faced-off end of the pump barrel. Centre, and drill right through with No. 40 drill until it breaks into the central hole in the valve box. Fit a $\frac{1}{4}$-in. × 40 union screw in the side of the D-bitted end, same as for the built-up valve-box; then press the connecting boss into the barrel, set the valve-box up straight, and solder over the joint, and the place where the union screw is attached. If the boss isn't a very tight squeeze fit in the barrel, put a 3/32-in. or 7-B.A. brass set-screw in, as shown in the illustration. Saw off the chucking piece, and file the stub flush with the valve-box, rounding it off to match the circumference.

### Same Details

The valves, valve caps, ram, lever and links are made and fitted in exactly the same way as specified for the built-up pump. An extension handle for either type of pump is made by rounding off the end of a piece of $\frac{1}{8}$-in. × $\frac{1}{4}$-in. rod, about $3\frac{1}{2}$ in. to 4 in. long, and fitting a socket to the end. The socket may be either a piece of rectangular tube which will just fit easily over the lever (this is a commercial article), or else it can be made by wrapping a piece of 18-gauge sheet brass around a piece of rod of the same section as the handle. If tube is used, push the rod into it for about $\frac{1}{2}$ in., and put a couple of $\frac{1}{16}$-in. brass rivets through the lot. If the socket is made from sheet, slide it on to the handle for about $\frac{1}{2}$ in., and silver-solder it, sealing up the corner joint at same time. When the pump is erected in the engine tank, it is operated by putting the extension handle over the pump lever, which is arranged to come exactly under the filler hole. No unsightly slot is needed in the tank top.

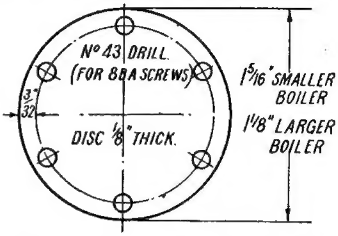
### Efficient Pumps

Beginners and new readers may be interested to learn that I have used and specified this type of pump for many years past. The old commercial pumps had a huge gland, which the packed ram renders unnecessary; and they also had levers pivoted at the bottom, below the ram. This necessitated huge long slots in the tank tops, as the end of the handle sometimes had to travel over $3\frac{1}{2}$ in., to get less than 1 in. stroke of the ram. I have here at the present moment, a rebuilt commercial $2\frac{1}{2}$-in. gauge engine which originally cost over £130; and in its original state, it had a 4 in. slot in the tank top, with a huge permanent handle projecting through it, yet the pump itself was only $\frac{3}{8}$ in. bore and 1 in. stroke. It is hardly necessary to add that this

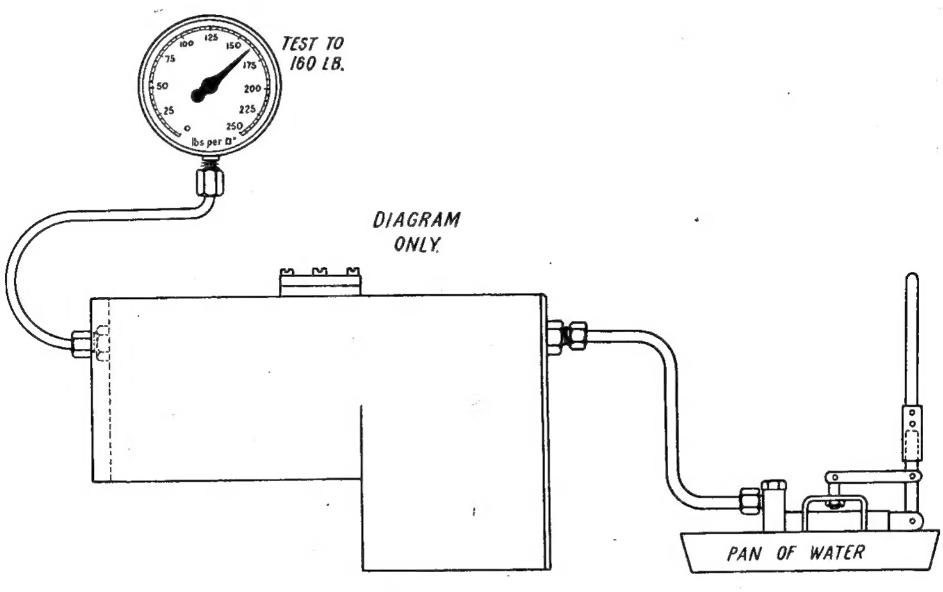
was scrapped, and replaced by an efficient pump, similar to that described above. I might add that my pumps with upper pivot and packed ram, have been pretty extensively copied!

## How to Test the Boiler

Having made the pump, the actual testing of the boiler is just a piece of cake. The reproduced diagram shows the whole set-up. Plug all the holes except two; the dome hole may be covered by a disc of brass $\frac{1}{8}$ in. thick, same diameter as the dome bush, which is $1\frac{5}{16}$ in. for the smaller boiler, and $1\frac{1}{8}$ in. for the larger. This is attached by six 8-B.A. brass screws in exactly the same way as a cylinder cover, with a Hallite or similar jointing gasket between disc and bush. Be careful to keep this handy after the testing, for you'll need it to use as a jig to drill the dome flange; otherwise you won't get the screw-holes in the flange, to match those in the bush. Two




*Temporary cover for dome bush*




*Rig-up for testing boiler*

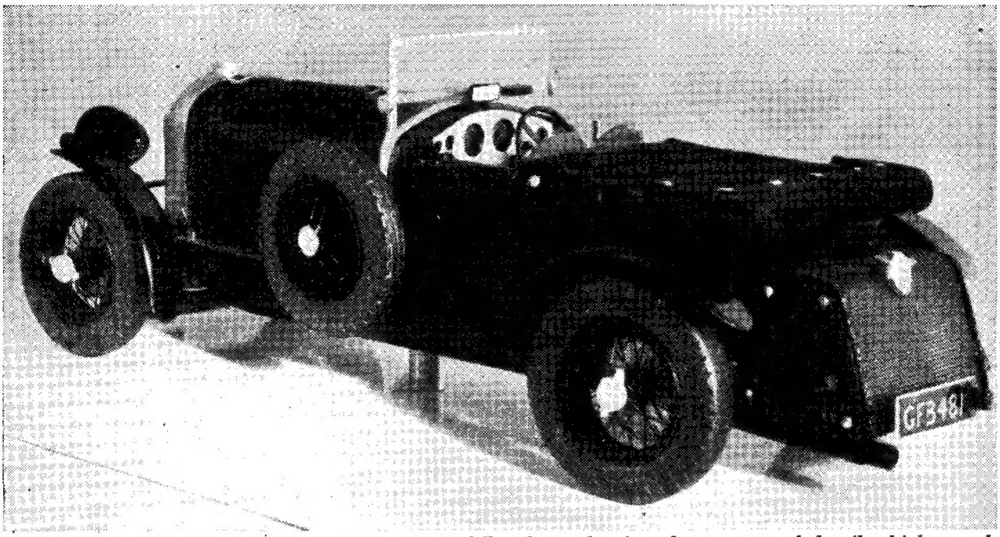
adapters are needed, as described and illustrated for the "pinhole" test, but one end of each is countersunk for a union.

The boiler is filled right up with cold water, and the big gauge attached by a piece of pipe with a union at both ends, to one adapter as shown; the pump is attached to the other, and placed in a pan or tray, with water in it. You will find it extremely easy to pump against pressure, by aid of the long extension handle; a few strokes will send the big gauge up to 50 lb. Stop here and take a look to see if all is O.K.; if so, go up to 100 lb. and take another look. Don't worry if the firebox crown or side sheets move 1/32 in. or so, as it will only be the soft copper settling itself into the best position to resist pressure. If still O.K. go to 130 lb and then finally to 160 lb. which is twice the working pressure; don't go higher, as it is unnecessary, and you only put undue strain on the boiler. If still O.K., leave the pressure on for a little while; then release it by unscrewing a union, drain out the boiler, and pause for a cup of the enginemen's best friend (or something a little more potent, according to taste!!) for you have well and truly earned it. Should a leak show, stop the test and put it right before proceeding further. We are then ready to adorn the boiler with the necessary fittings and mountings; see coming instalments of this serial story.

## Passing Thought for The Week

The new standard locomotives of British Railways, judging by the cab and tender front "mock-ups," will be different in design to any other engines now running. Will the friends and relations of Inspector Meticulous therefore designate them as "free-lance"??

# Model Car Supplement



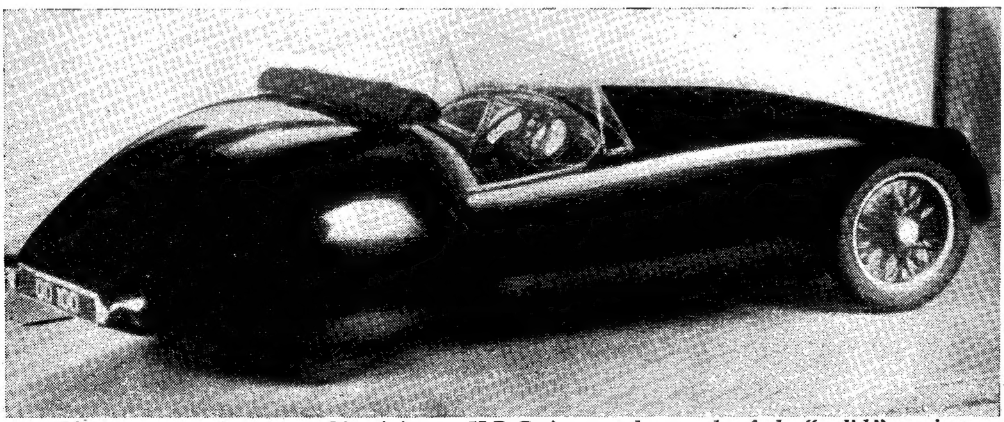

*A popular scale miniature, one of a long line of Bentleys, showing the amount of detail which can be embodied in a relatively small model*

# THE SPICE IN VARIETY

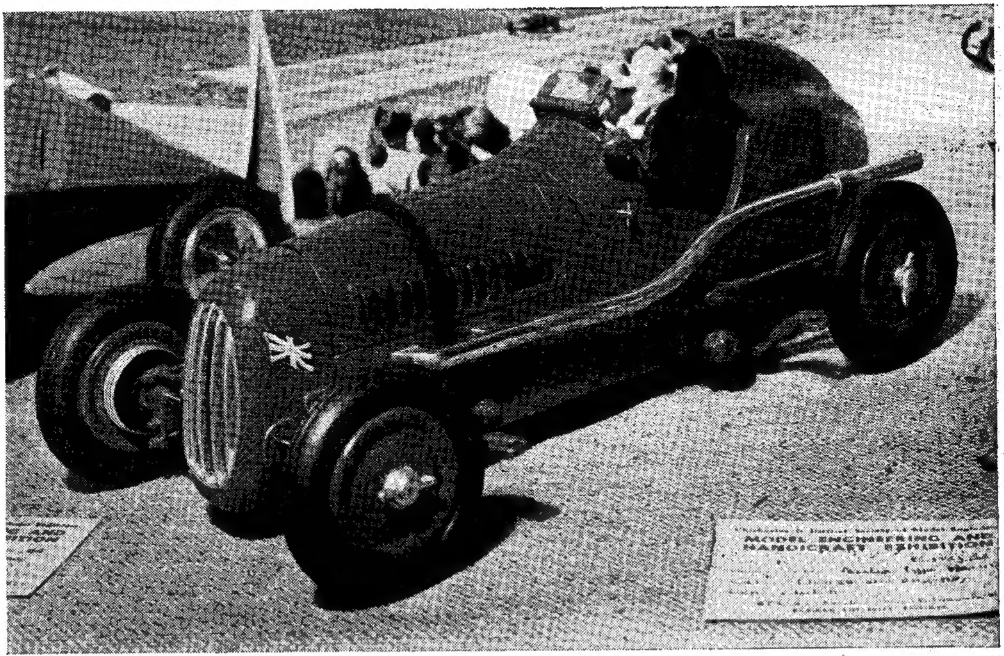
## by G. W. Arthur-Brand

IN the early days of the model car movement, almost every enthusiast went to work on his model with some known prototype firmly imprinted in his mind's eye. That this state of affairs should have been allowed to deteriorate is largely responsible for the view often taken by serious model engineers that model cars, and the "sport" of racing them, can hardly be claimed even as a *branch* of model engineering.

It would take far too long, and occupy a great deal more space than we are able to devote to the subject, to enumerate the advantages of the older type of model car over the disadvantages of the present species; but in order that readers should not get the impression that all model cars, even today, are devoid of model engineering interest, I would draw your attention to the eight photographs which appear on this and



*Of the more modern type, this miniature H.R.G. is a good example of the "solid" variety*



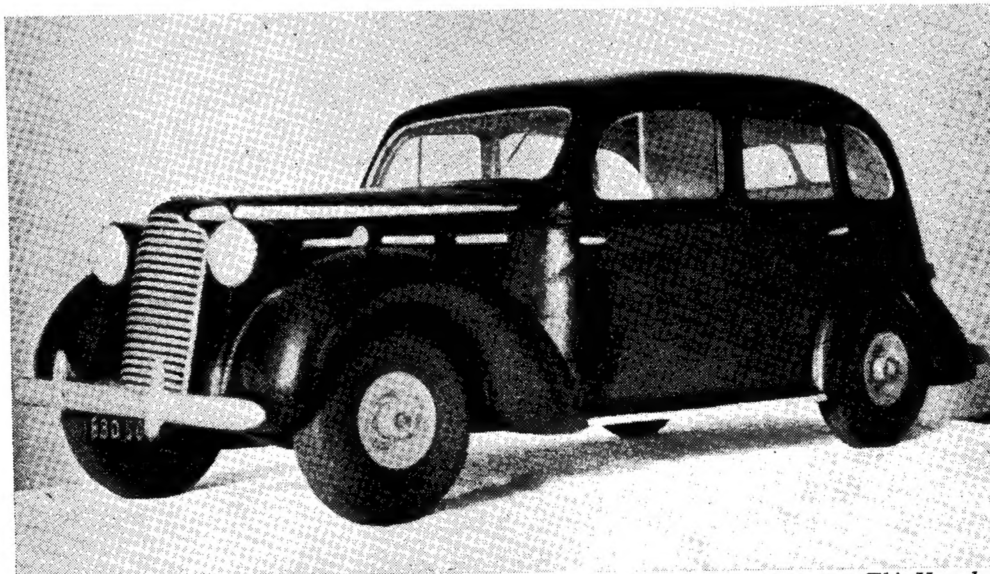
*A semi-scale model of the o.h.c. Austin racing car. Not as fast, perhaps, as the commerical " speedster," but infinitely more interesting and quite distinguishable*

the following pages. You will agree, I am sure, that there is a great deal of variety in the subjects available.

As will be seen, motor modelling can be split up into four distinct categories :—

(1) Scale miniatures.
(2) Detailed scale models.
(3) " Prototype " designs from the constructor's own board.
(4) Scenic layouts, employing one or more of the previous three categories.

These four categories may be further divided into functional or non-functional, assisted or self-propelled, etc., etc., *ad infinitum.* The



*The saloon type of model is a great deal more popular now than it was a few years ago. This Vauxhall is an exceedingly good example of what is being done*

*Having built a scale model of a saloon car, the obvious "follow on" is a caravan. A brief study of this picture will reveal the many branches of carpentry, engineering and kindred crafts involved*

*A good example of a working scenic model employing a wide range of automobile modelling interest*

*In the prototype class, one of the most recent developments is the banked, oval rail track allowing several cars to be raced. The obvious development would be a Grand Prix circuit on similar lines—then, perhaps, radio control?*

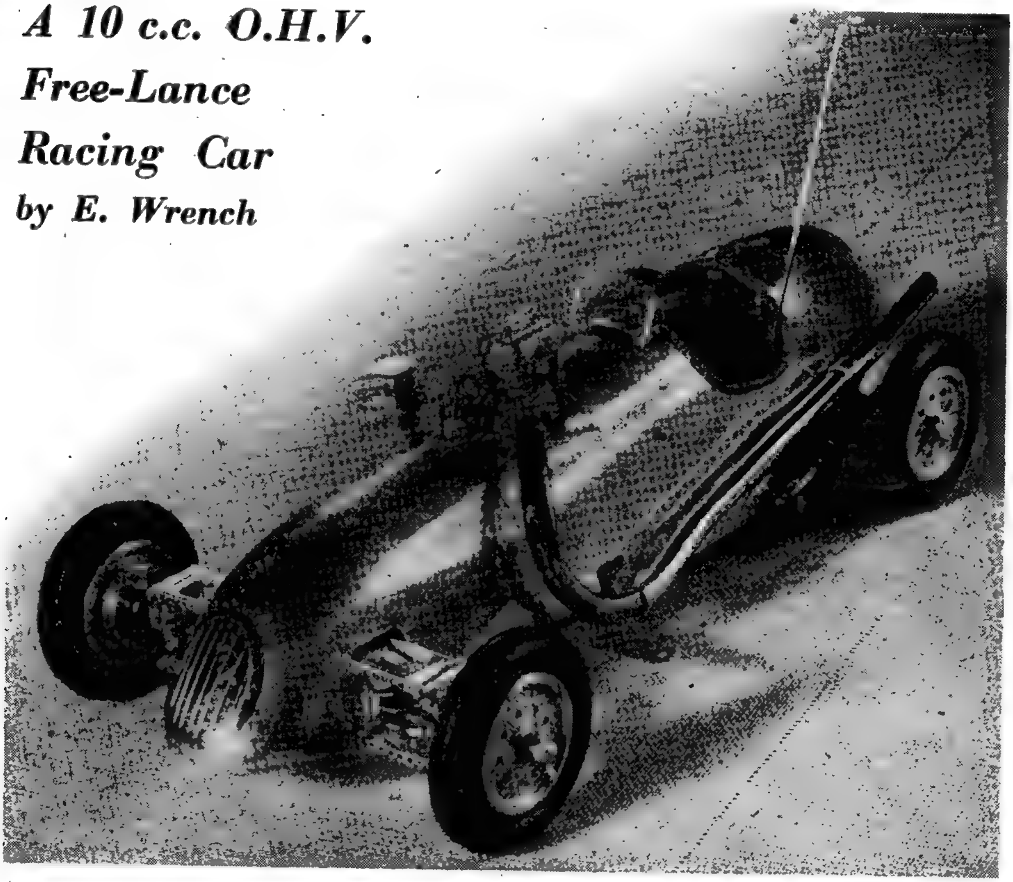
semi-scale and purely functional "racing" miniatures of the present era are not included, as it is considered that they do not come within the territory of the model engineer. It could, of course, be argued that they provide an excellent test bed for miniature internal combustion engines, but as so few of the engines which power them are, in fact, the work of model engineers, I do not propose to dwell on the subject here.

My whole object in writing this article is to endeavour to attract a new line of thought to what could be a most worthy pastime.


*A good example of a r.t.p. prototype of the pre-fanatic era, a "special" on the lines of the Auto-Union but with no claim of any connection*

# *A 10 c.c. O.H.V. Free-Lance Racing Car*

***by E. Wrench***



IT was through the excellent articles appearing from time to time in THE MODEL ENGINEER on this subject that I was inspired to "have a crack" at building a model car. It was not my intention to attempt a "super speed" model, mainly through lack of experience in this field, but rather something a little out of the ordinary from the usual type of two-stroke powered model.

After studying various makes of engines on the market I finally decided on a 10 c.c. o.h.v. "C.I. Special." I drew up the plans of the car and obtained a set of castings and parts for the engine and a "1066" back axle and gearbox. I spent a considerable time on these and all turning, etc., was accomplished on a 5-in. Lang lathe of German manufacture, which I was allowed to "borrow" from time to time. After running the engine in on the lathe for approximately four hours and on a test bench for another four, I was satisfied with the results, so I commenced work on the chassis.

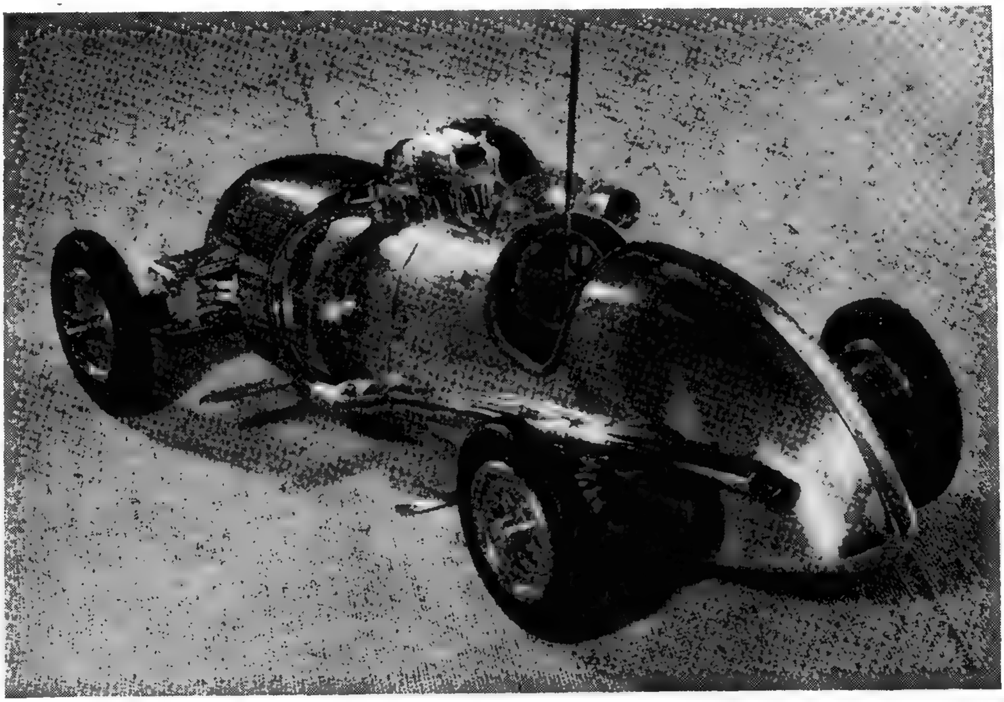
The chassis is constructed of two dural channel-section side members with cross members of the same section at the front and rear and the engine mounting plate in the centre. The front wheels are independently sprung with coil springs and the ¼-in. silver-steel stub axles are carried by two dural wishbones of equal length, as can be clearly seen in the photograph.

The whole of the front suspension was hand filed from ¼-in. dural plate and drilled for lightness, the chassis member and stub axle ends being laminated and riveted. Drag links were silver-soldered to the stub axles at the correct angle and the complete stub axle assembly swivels on $\frac{3}{16}$-in. hardened king-pins. Steering is effected by means of a track rod connecting the drag links and a strip of spring steel silver-soldered to the centre of the track rod, the other end having a ½-in. slot through which a $\frac{3}{16}$-in. bolt anchors it to a ⅛-in. sheet dural cross member of the chassis. As the wheels travel up and down, the track rod must, of course, travel with them; the strip of spring steel is long enough to flex up and down and is also wide enough to prevent any side movement when the $\frac{3}{16}$-in. anchoring-bolt is tightened down. To alter the steering, it is only necessary to slacken the anchoring-bolt and move the spring steel strip sideways the required amount through the slot provided. It works quite well in actual practice and the spring steel strip provides a damping effect on the coil springs.

The rear driving axle is also sprung on small

coil springs but the travel is limited to ¼ in. due to the transmission ; the axle is supported by two dural torque arms anchored to the chassis side members.

Mounting the engine became a problem due to its large proportions, caused by the overhead valve gear and the position of the throttle and mixture controls mounted on the cylinder-head. I toyed with several ideas of laying the engine on its side obliquely in the chassis, but was always confronted with some difficulty, the oil supply being one, as this engine has a separate oil tank mounted on the crankshaft housing and operates through an adjustment needle and hollow crankshaft by crankcase depression.



Power is transmitted by a three-shoe centrifugal clutch through a ball-pinned shaft and socket to the plain bushed bevel geared back axle, both the rear wheels driving.

The petrol tank is mounted in the tail and petrol is pressure-fed to the carburettor when the fuel level drops, by a forward facing vent on the filler cap. Ignition is by coil and I use a pen-cell pack which I find gives a really good reliable spark, provided it is looked after and depolarised after every run, and the cut-out is a tiny tumbler switch fitted with a removable extension.

The body is a " 1066 " 20-gauge pressing in aluminium, which was rather too short, so I cut it in two and rivéted a section of 18-gauge in the middle to cover the engine compartment. This increased the length as required and also provided a strong reinforcement for the rear half of the shell which clips on to the chassis and can be removed in a couple of seconds for refuelling and making adjustments, etc. A radiator grille was made from scrap and together with the copper exhaust was chromium plated. A streamlined driving mirror, windscreen and an instrument panel with dummy steering wheel completed the car. It was then balanced and fitted with bridle attachments, the all-up weight coming out at 6 lb.

This model was built in Berlin during my spare moments, and, as there are no clubs there, the best testing ground available was an old *ex*-Luftwaffe aircraft hangar.

I have had the car running several times on a 40-ft. line, but due to the bad surface I have not been able to open the throttle more than two-thirds, at which we have timed it at 60 m.p.h., the independent suspension really taking some punishment.

Some model race car fans may say, " Why choose an o.h.v. engine which is difficult to enclose ? " Well, one has only to hear a miniature four-stroke engine running to know the answer. This particular engine is very flexible ; it starts first pull and runs almost silently with the throttle barely open, the copper exhaust emitting a deep howl as the throttle is opened.

As for the out-of-scale appearance of the cylinder-head protruding through the cowl, well, I am working on another body to enclose it, but for the time being the carburettor controls are easy to adjust whilst running, and the head certainly gets well cooled.

Details of the car are : overall length, 17 in. ; wheelbase, 12 in. ; track front, 8 in. ; track rear, 7 in. ; all-up weight, 6 lb. ; wheels, 3½ in. dia., " 1066."

# IN THE WORKSHOP

## by "Duplex"

### No. 76.—*A Small Power-driven Hacksaw Machine

WHERE simplicity is desired, it will be sufficient for operating the machine if the motor is wired direct to the electric power circuit and controlled in the ordinary way with a tumbler switch.

It will, however, add greatly to the convenience of working if a small on-off switch is fitted on the machine itself and, in addition, an automatic cut-out switch is used to switch off the motor as soon as the saw teeth reach a point a little below the level of the vice work-face. This automatic switch will enable the machine to be left unattended while working, with the knowledge that the driving motor will be stopped on completion of the cut. Furthermore, by fitting the main switch and the control button of the automatic switch at the near end of the machine, the hands are kept well clear of the saw mechanism and any live electrical connections.

**Continued from page 687, " M.E.," November 2, 1950.*

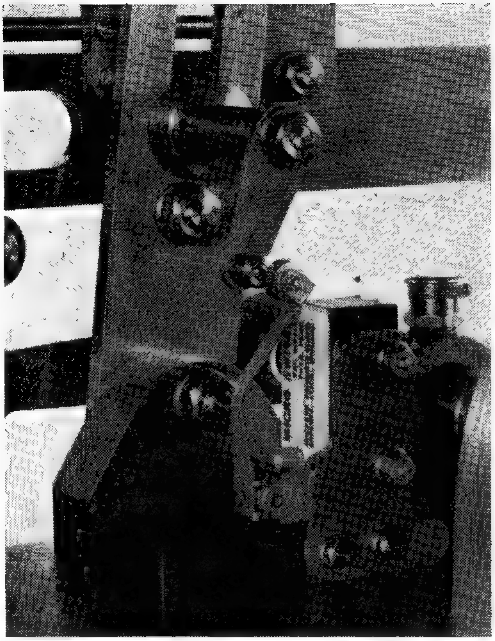
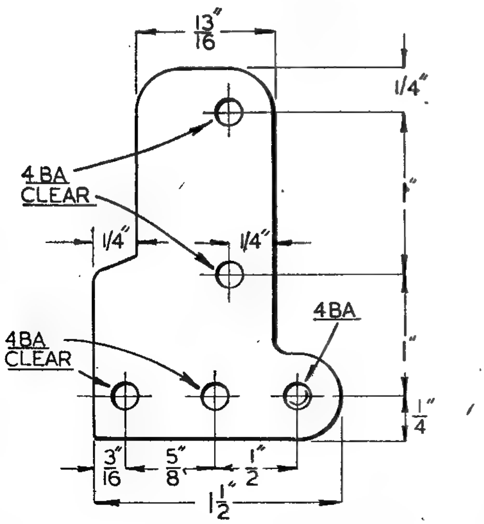


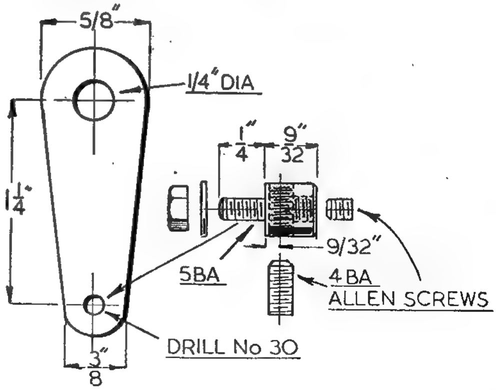
*Fig. 47. The Burgess switch fitted in position*

### The Cut-out Switch

The switch used for this purpose in the a.c. circuit is the Burgess BRSX micro-switch fitted with a base mounting and a CA type actuator for operating the switch mechanism.

This type of switch has a reset button for again closing the circuit after it has been broken, and, as will be seen, a remote control




*Above—Fig. 49. The drop-arm attached to the guide-arm shaft*

*Left—Fig. 48. The switch bracket*

gear is fitted to perform this duty. The method of mounting the Burgess switch is illustrated in Fig. 47, where it will be seen that the base mounting of the switch carrying the actuator arm is secured to a bracket which, in turn, is fixed to the guide-arm base bracket casting by means of two screws engaging in the tapped holes previously drilled in the latter part. The dimensions of the attachment bracket are given in Fig. 48. Before going further, it should be pointed out that the reset button and its operating gear are arranged to lie along the centre-line of the baseplate of the machine, and it may, therefore, be found necessary to fit spacing washers between the switch attachment bracket and the casting in order to get the correct setting.

As will be seen in Fig. 47, the actuator arm of the Burgess switch is moved by a drop-arm fitted to the end of the guide-arm shaft attached

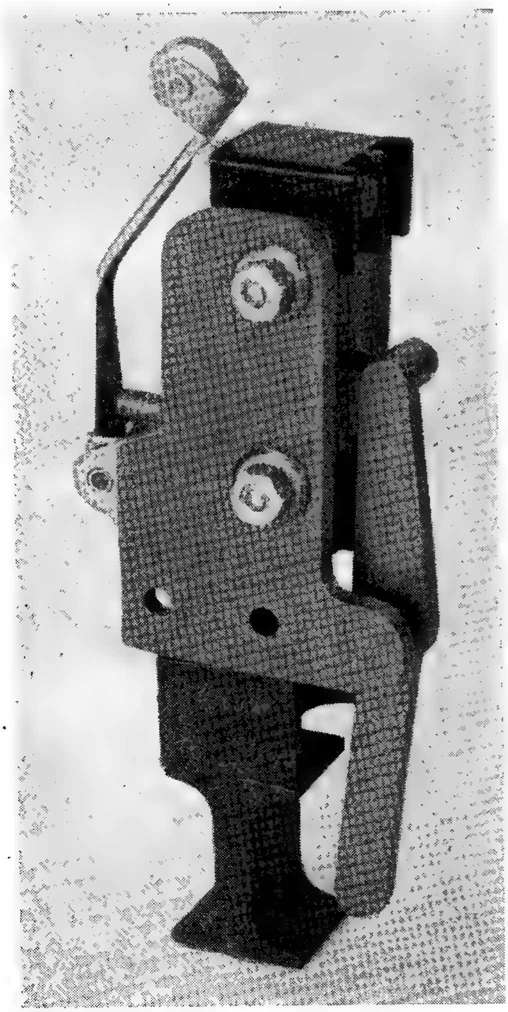


*Fig. 50. The Burgess switch with its bracket and reset lever*

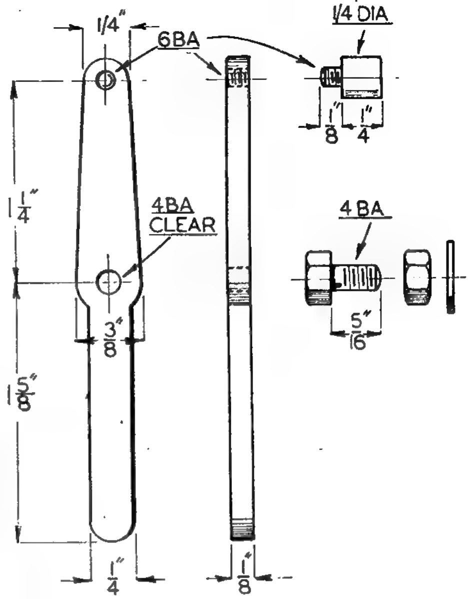



*Fig. 51. The reset lever with its parts.*

to the saw beam. It follows, therefore, that, as the beam falls, the downward movement of the drop-arm will cause the actuator to operate the switch and so break the circuit.

It will be remembered that, as shown in Fig. 32, the projecting end of the guide arm shaft is shouldered and threaded ¼ in. B.S.F., and it is here that the drop-arm is attached by means of a nut and washer. The detailed construction of the drop-arm and its fittings is shown in Fig. 49, and it will be apparent that the contact screw of the arm is adjustable over a wide range in relation to the roller contact fitted to the actuator arm; there will, therefore, be no difficulty in setting the switch to break exactly at the point required.

## The Reset Mechanism

The photograph, Fig. 50, of the switch detached from the bracket casting shows the way in which the reset lever is mounted on the switch bracket for the purpose of depressing the button that resets the switch. The dimensions of this lever and its parts are given in Fig. 51. The lower end of the reset lever, which can be seen in Fig. 52, passes through a slot, formed in the baseplate of the machine, to enable the lever to be moved by the actuating mechanism fitted to the under side of the base. The photograph, Fig. 52, of the under side of the baseplate gives a general view of the operating mechanism, and the constructional details are shown in Fig. 53; the parts are identified by similar lettering in the two illustrations. When fitted as shown, the control-rod lies both on the centre-line of the baseplate and parallel with its lower surface; this enables the bearing for the rod to be marked-out and drilled at the centre of the upper of the

two bosses cast on the baseplate leg, as represented in Fig. 53F.

The position of the spring housing (*B*) and the return stop (*C*) should be adjusted so that the end of the control-rod (*A*) is just clear of the reset lever and, when the finger-button is pressed, the resulting travel of the control-rod should be just sufficient to reset the switch with the saw beam in the raised position. A small Bulgin, panel-mounting switch is fitted in a hole drilled in the lower boss of the leg casting, and this switch in the ordinary way serves as a control switch for the motor; it will, however, be found that, with the beam in the raised position, pressing the reset control button is a convenient way of restarting the motor.

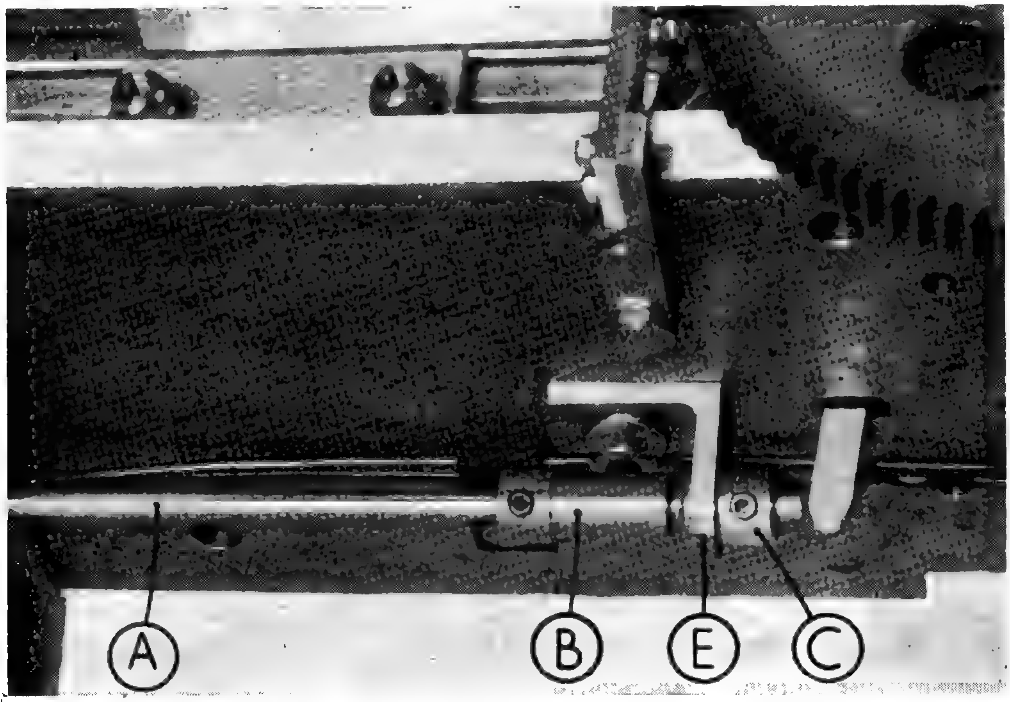



*Fig. 52. The reset mechanism. (A) the control-rod; (B) the spring-loaded forward stop; (C) the back-stop; (E) the bearing bracket*

### Wiring Connections

The diagram, Fig. 54, shows how the wiring connections are made, and the actual run of the wiring is represented in Fig. 55. A junction box is secured to the under side of the baseboard to receive the incoming current and supply it to the motor through the Burgess switch and the main switch. Both these switches are connected in series in the positive or live lead, as shown in the wiring diagrams.

An earthing connection is made to the motor and also to the machine itself by means of the bolt, already mentioned, which secures the aluminium leg casting to the wooden base.

The wire used for making the electrical connections has a single strand of 18-gauge wire covered with a thick layer of black plastic material. To protect the wiring from being chafed, ebonite or plastic bushes, of the pattern illustrated in Fig. 56 are fitted to both the baseplate and the baseboard.

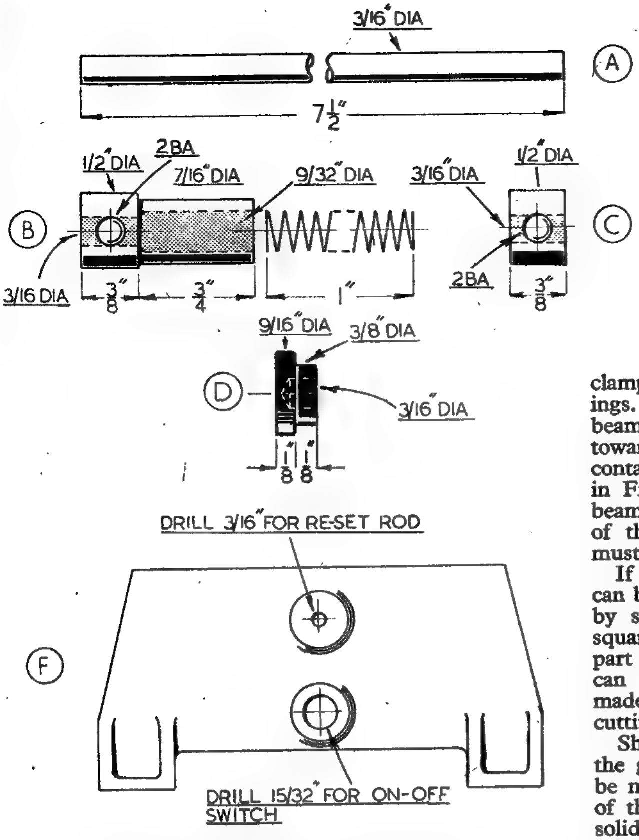
To enable the wiring to be neatly arranged and kept in place, two ebonite wiring cleats, Fig. 57, were fitted to the under side of the baseplate; their ¼ in. B.S.F. attachment studs engage for a short distance in the holes already tapped in the baseplate for the Allen screws used to secure the main bracket castings in place. The wiring between the junction box and the switches is in two sections, which are joined together on the under side of the baseboard by means of the two connectors shown in Fig. 58. This arrangement not only facilitates making the actual connections, but also allows the machine to be removed from its baseboard without having to upset the wiring.

On completion of the wiring, the machine is ready for a practical test, and only needs painting before being put into regular use.

### Testing the Machine

Before running the machine, it will be found instructive to carry out some simple tests to check the accuracy of the construction.

Mount the test indicator on the baseplate and, as represented in Fig. 59, traverse the blade for the full length of its stroke; this will show whether the saw teeth travel in a straight line relative to the beam slide. If the saw blade is found to be out of alignment, this can be corrected by filing the



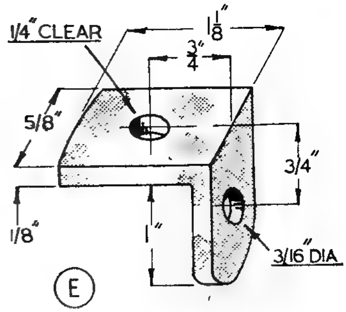




*Fig. 53. The reset mechanism. Lettering identical with Fig. 52. (D) the control-rod button; (F) drilling locations in the leg casting*

clamping face of one of the blade mountings. To test the vertical alignment of the beam pivot bearing, run the weight back towards the pivot and, with a square in contact with the weight, as illustrated in Fig. 60, raise the beam. Should the beam not rise squarely, the bolting face of the beam pivot arm on the casting must be corrected.

If all is found to be in order, the vice can be lined up to hold the work squarely by setting the fixed vice jaw against a square held in contact with the plain part of the saw blade. The machine can now be started up and some trials made to test the speed and accuracy of cutting.

Should there be an undue noise from the gear drive, the fabroil pinion should be meshed rather more closely by means of the adjustment provided, and a little solidified oil should be applied to the teeth; when correctly adjusted, the gear drive should be almost noiseless. The driving belt should be tensioned

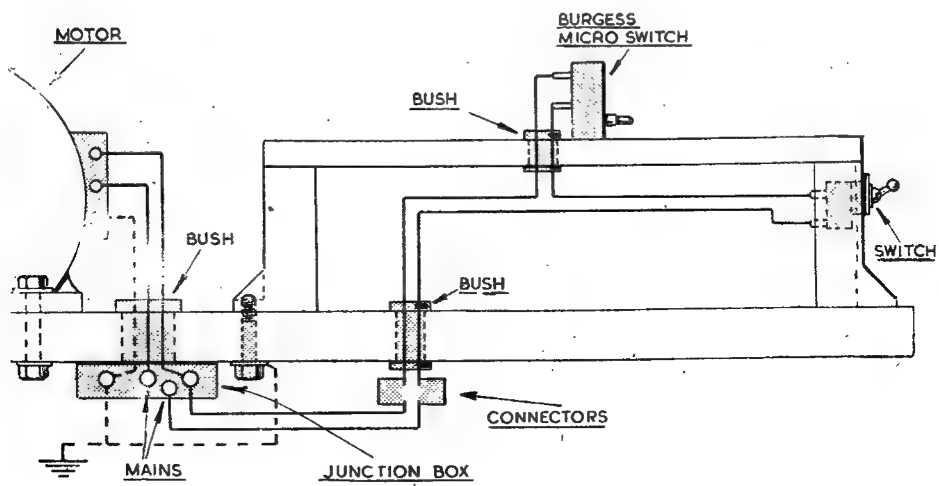



*Fig. 55. The wiring connections*

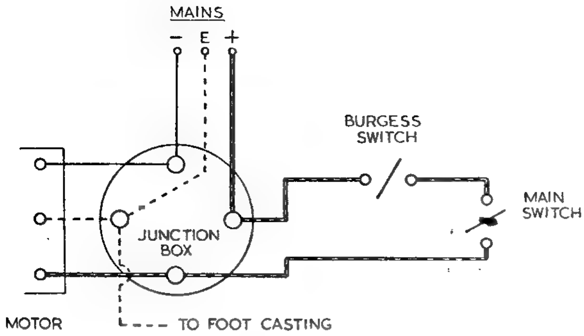



*Fig. 54. Wiring diagram*

just sufficiently to prevent slip, for further tightening will merely increase the bearing friction and lead to unnecessary wear.

Keep all bearings well lubricated with thin oil of good quality; this is especially important for the carriage slides, as failure of lubrication may result in scoring of the contact surfaces. To keep the machine and the bench top clean, it is advisable to use a swarf tray that will slide partly under the baseboard; the chips accumulating on the machine can then be swept into the tray with the brush kept at hand for the purpose.

### A Small Addition

Some difficulty may be experienced in forming an oiltight joint where the nut clamps the countershaft to its bracket casting. This can easily be overcome by fitting a cap nut in place of the plain nut shown in Figs. 7 and 8.

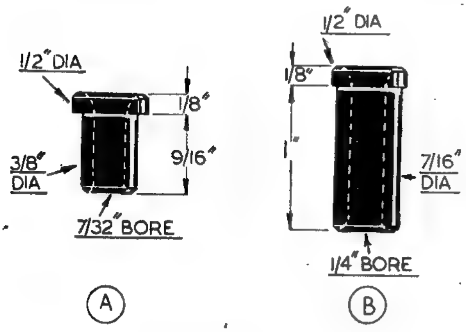



*Fig. 56. Wiring brushes. (A) for the baseplate; (B) two required for the baseboard*

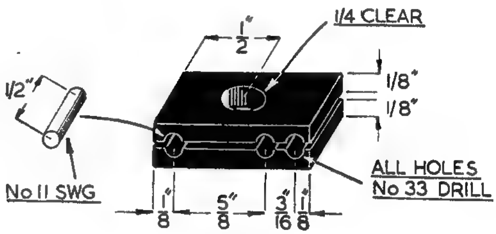



*Fig. 57. A wiring cleat with its spacing-rod*

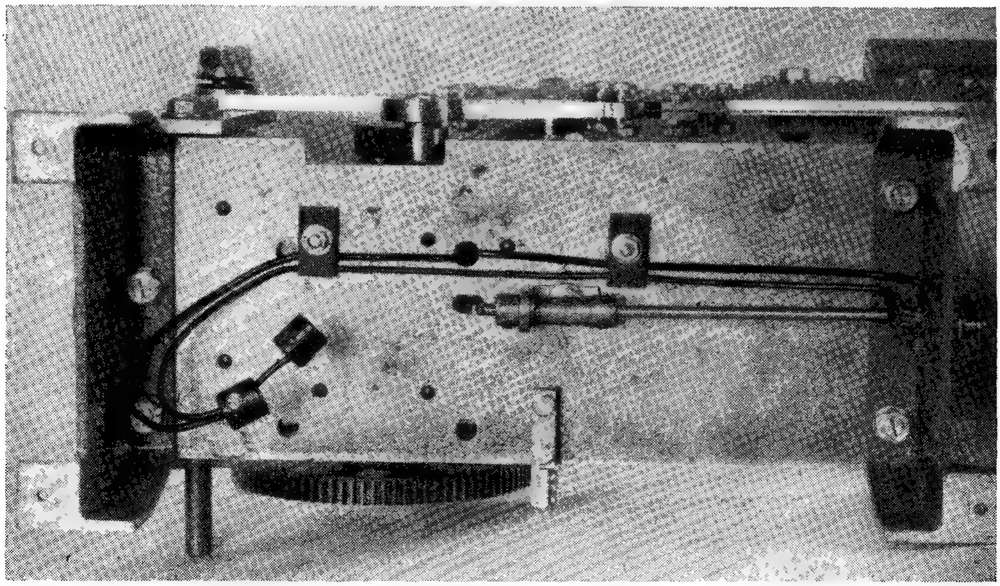


*Fig. 58. Showing the wiring under the baseplate, also the reset mechanism*

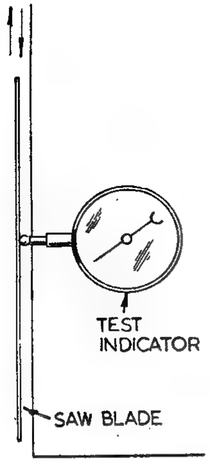



*Fig.* 59. *Testing the alignment of the saw blade*

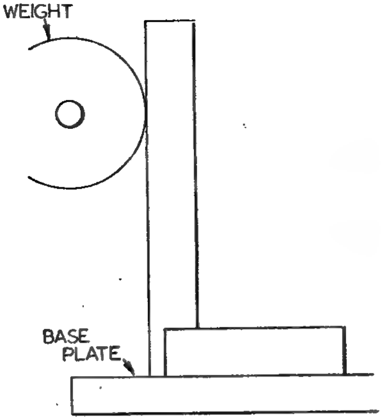



*Fig.* 60. *Testing the alignment of the beam pivot bearing*

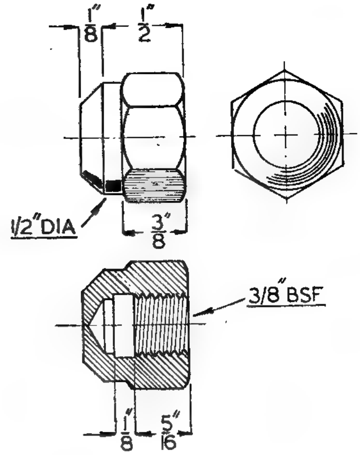



*Fig.* 61. *The cap-nut fitted to the countershaft*

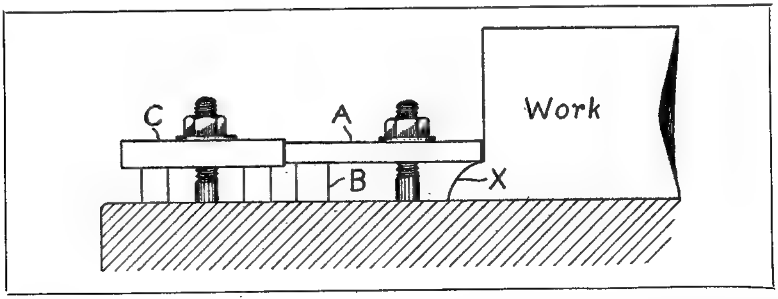
A suitable nut for the purpose is illustrated in Fig. 61. When threading this nut, a second tap was used, that is to say one having its leading threads tapered ; so to enable the nut to engage fully, without binding on the threads, a small boring tool was employed to chamber the bore as represented in the drawing.

In a following instalment a description will be given of this machine in a simplified form adapted for attachment to the lathe bed and driven from the lathe mandrel.

(*To be continued*

# A Clamping Hint

OFTEN a job comes along to be machined on the lathe faceplate or on the shaping machine, which is difficult to clamp down due to the absence of any square ridges or ledges. Sometimes the lathe dog chucks can be used to make the work quite secure for machining operations, due care should be paid to one or two points. First, make quite sure the packing-piece *B* is not longer than the height of the projection *X*. The clamp *A* should be level, or, if




and, if so, the problem is solved; but in many cases even this method cannot be applied.

The accompanying illustration indicates part of a job which contains a number of rounded projections, as shown at *X*, and the work has to be clamped down on these pieces. In order anything, sloping slightly down on to the packing.

Behind each clamp, bolt down a stop-piece *C*, making quite sure it is in good contact with the end of *A*. This stop will tend to prevent the holding-down clamp slipping off the work while machining operations are in progress.—W. J. SAUNDERS.

# A 7½ c.c. Split-Single Two-Stroke

## by W. S. Laycock

LOOKING around for an out-of-the-rut model some time ago, I came across a diagrammatic layout of the "Trojan" light van engine, and it occurred to me that a single-cylinder variation of this type, with a lower stroke-bore ratio, might be fairly useful. I schemed out the general arrangement shown in Fig. 1.

The job was planned for carving from the solid, and the first step was to order a foot of 3-in. dural bar. There would be, it appeared, a few weeks' delay in delivery, so I busied myself with these as plain "pots" leaving 0.010 in. on the o.d. for final machining. I then set up a small angle-plate on my lathe faceplate, mounted a spigot on the angle-plate, and bored the pistons ¼ in. diameter for gudgeon-pin bosses, which were made of the same material as the pistons; a material which I know as semi-steel, and rather like a fine-grained cast-iron in its properties. These properties, by the way, include a distinct aversion to silver-soldering, which process I wished to use to fix the gudgeon bosses. However,

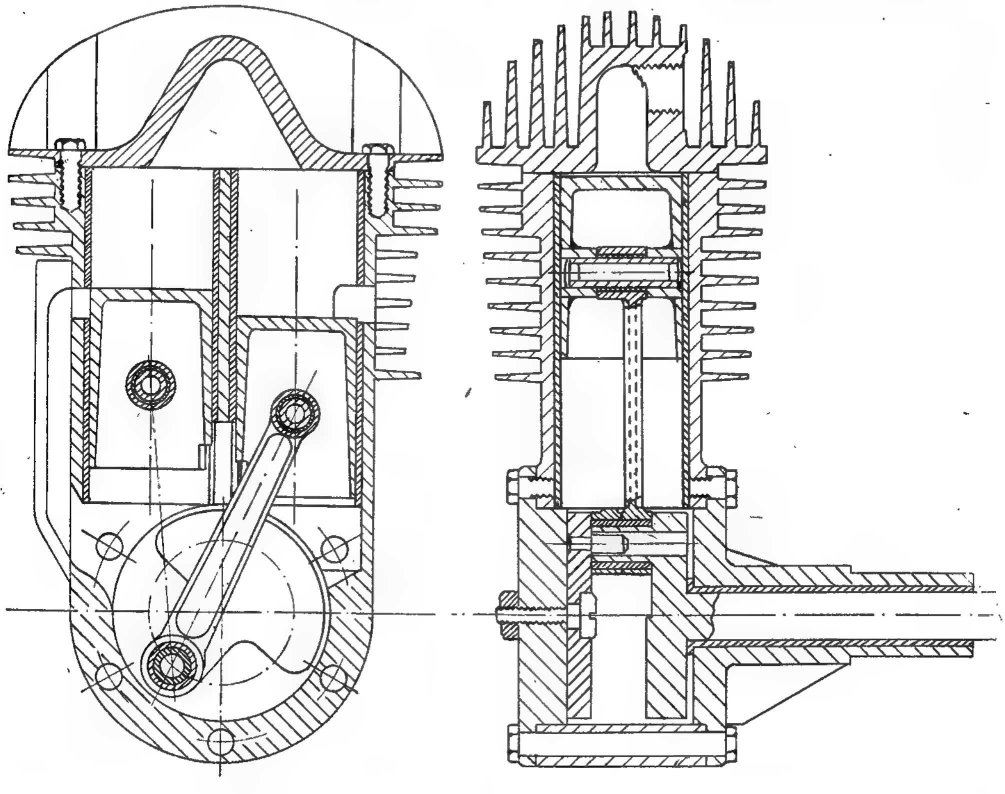


*Fig. 1. Full-size vertical sections of the split-single two-stroke engine*

cylinder liners and pistons. The liners were made from a stick of "Meehanite" cast-iron, which proved to be a very suitable material for the purpose; they were turned plain, without a top shoulder, to enable me to get close pitching of the cylinder head bolts. The outside diameter was made 0.6885 in. to press into an 11/16-in. hole, and I bored them ⅝ in. and rough lapped them to save time on final finishing.

Turning my attention to the pistons, I machined by "burnishing" the bosses and holes wi. brass rod, I encouraged the silver-solder to flow, and made quite a fair job of it.

The crankshaft was next taken in hand, and turned from a piece of mild-steel bar, the crank-pin being turned and drilled by holding the main journal in a brass bush held eccentrically in the 4-jaw chuck. Then, with much trepidation, the piece was heated, rolled in Kasenit, and quenched. How I blessed the makers of that steel! Less

than 0.001 in. distortion in the length of the shaft! So I polished it, oiled it up, and put it away with the other parts.

The end-cover carrying the main bearing was the next piece to come under consideration. This I machined up from a piece of 1$\frac{3}{4}$ in. diameter dural bar, turning, milling and shaping to leave three supporting webs. A hard bronze bush was shrunk into place, and the spigot and bolting face were machined up, locating, by the bore, on a mandrel.

The rotary-valve side cover was also machined from the same material; a piece of $\frac{1}{8}$-in. gauge plate provided the rotary valve, which I hardened and tempered, finishing off by lapping on a cast-iron plate.

If I might digress here for a moment; there are occasions on which a *light alloy* face requires to be highly and accurately finished. I have found that excellent results can be obtained by the following process. Take a square of $\frac{3}{8}$ in. gauge plate, harden it right out, then take it along to the nearest factory which boasts a surface grinder, and have it faced both sides with a coarse grinding wheel; ask to have it *flat*, but coarsely finished. When you wish to use it, flood it with paraffin, and rub your component firmly over it with a circular or figure-eight motion. The plate must be kept flooded, and frequently cleaned; you will find that a fine aluminium "paste" is formed, as the thousands of little cutting edges left by the grinder do their work. A 3 in. square is a very handy size for small i.c. engine facings.

But to pass on to the next item; the connecting-rods. The rod is offset from the little-end, to allow both rods to work side by side on the same crankpin. They were machined from mild steel, with identical centre-distances, and case-hardened. Then I lapped out the two little-ends, put them on a tight-fitting mandrel, and checked for bending. I was lucky again; so with both rods on the one mandrel, back to back, I lapped out the big-ends as one hole, thus ensuring reasonable alignment and parallelism. I fitted floating bronze bushes to each little-end, and gudgeon pins to the bushes, after which I bored the pistons for the gudgeon pins. A long floating bush for the big-ends completed this part of the work.

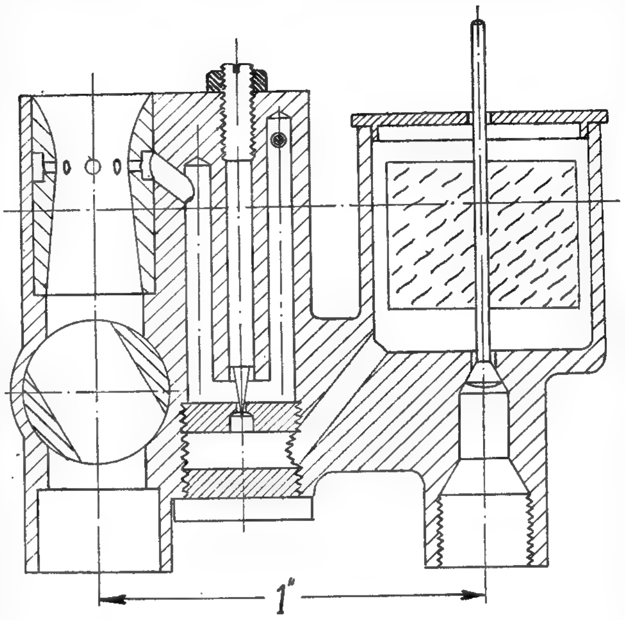



*Fig. 2. Section of the carburettor (twice full size)*

There was still no sign of the 3 in. dural bar which I had ordered, so after making up the contact breaker and a flywheel I turned my thoughts towards the construction of a real carburettor. After lengthy perusal of the works of the masters, I evolved the gadget shown in Fig. 2. The body is carved from a solid block of dural, and the instrument was originally fitted with a float soldered up from 0.003-in. brass foil. However, since the day the unit caught fire, a varnished cork float has been used, with no ill-effects!

At this stage in the proceedings it occurred to me that I could incorporate a "hot-spot" induction pipe. By inclining the engine at 60 deg. from the vertical, and sweeping the exhaust pipe below and to one side of the crankcase, I saw that I could flange the induction pipe to the crankcase cover, and flange the exhaust pipe to the bottom of the induction pipe, with a strip of copper foil between the two, to provide the "hot-spot." The layout is seen in Fig. 3. The sharp right-angle bend in the gas-flow may seem inefficient, but results have been good, although they might possibly be better with a straight horizontal inlet.

At the same time as I made the carburettor, I also made a perspex copy of it, which I tried out on a 5 c.c. engine. It was quite interesting and instructive to watch this carburettor under working conditions, but more could doubtless have been learnt by the judicious application of a stroboscopic viewing device.

By this time the 3-in. dural bar had arrived, so I cut off two pieces and machined them up into rectangular blocks for the cylinder and head. I then bored the body block for the crank tunnel, and faced the ends to thickness. Next, the cylinder head bolt positions were marked out, drilled, tapped, and the two blocks assembled temporarily. After milling and filing to the shape shown in Fig. 4, I marked off the cylinder bore centres on top and bottom of the composite block, and centred them with a small centre drill. The fin spaces were next milled along the sides, and the ends finished by "pumping" in the lathe on the centres previously machined.

To machine the cylinder bores, I set up the composite block on the faceplate with one of the centres running true, removed the head, and bored one cylinder. Then, replacing the head,

the operation was repeated for the second bore. I then fitted the liners, milled the transfer and exhaust faces and ports, and finished the body to shape.

The head was taken in hand, and the combustion space milled out with the set-up shown in Fig. 5, after which I filed the external shape and machined the fins with the same cutter as I used for the body.

The cylinder liners were finish-lapped, and I turned up the pistons 0.001 in. oversize, finishing to a fit with a fine flat stone used as a "hone." This was done on a "standard" type of piston-turning fixture, i.e. a short location spigot and eyebolt, with a dummy gudgeon-pin.

After making up the bits and pieces, and assembling, compression proved to be so fierce that I had severe misgivings about the possibility of starting the brute! However, I connected up an ignition circuit, and a "fuel tank" (which looked suspiciously like a mustard tin!), and started the "diabolo drill." Twenty minutes of this, interpolated with occasional carburettor-twiddling, produced a few isolated explosions; then I had what proved to be an inspiration, and bent up a piece of thin brass sheet, which I clipped over the carburettor to form a strangler.

A few more pulls and twiddles, and away she went! I cautiously opened up the throttle and strangler, and let her run on half throttle for a few minutes. She seemed to be running rather unevenly, so I put my thumb on the flywheel, and she settled down to a perfectly steady tearing sort of crackle! But what kind of smell is this from the exhaust gases? It was quite a few minutes before I placed it as the real full-size smell, quite different from the usual exhaust odour of a small model. I put this down to the advantage that the split-single possesses in the matter of reduced charge loss. Further experiments have later strengthened this theory, in the following results: (1) with open exhaust ports, no flame is visible in the exhaust ports at any setting of the controls; (2) comparative fuel consumption tests showed that at comparable speeds, the consumption of this engine ($7\frac{1}{2}$ c.c.) was only 65 per cent. of that of a 5 c.c. single two-stroke of conventional design.

But to revert to the narrative; I ran the engine several times at the same settings, until she seemed to have settled down a bit. Then I opened up the throttle to full bore, and tried closing it down as far as possible; repeating this performance at several settings of the main jet and air-bleed jet, until I found what appeared to be a satisfactory setting. The engine was then very flexible indeed, running at a mere crack of throttle at a really low speed; the engine would respond immediately to the throttle, even when slammed wide open from the idling position. A sudden loading with a wooden brake-block caused no stalling; the engine seemed to just settle itself down and "get its shoulder to the wheel" without any fuss. The carburettor, in fact, seemed to provide all that could be desired in the matter of compensation. I discovered, incidentally, that when the engine was warmed up, I could start her by simply pulling her over T.D.C. by hand!

I was highly satisfied with the unit at first, but after a while, the urge came upon me to try to develop the job a little. I therefore rigged up a brake and a revolution counter, and took a few b.h.p. readings. Plotting these gave a maximum of about 0.2 b.h.p. at 5,500 r.p.m. The engine, however, under load for several minutes, was getting hot and losing compression. A little consideration revealed a possible explanation, as follows: The liners, being a press fit, were subjected to a compressive stress, when cold; but on heating up, this stress was removed due to the greater expansion of the dural surrounding, giving the effect of a greater expansion in the liner bores. I decided not to worry about this at the moment, but to proceed with an experiment in the reduction of friction.

It will be seen that, due to the piston spacing being identical with the stroke, and centrally disposed, there is no reversal of side thrust on the cylinder walls, i.e., the inner cylinder walls take no part in supporting the piston.

On this assumption, I cut away the pistons as shown in Fig. 6, reassembled the engine, and took a further test. This gave a power peak of 0.24 b.h.p. at 6,600 r.p.m., quite a gain! An interesting sidelight on this was that when I checked compression, immediately after stopping the unit, it was quite good, but fell off in two or three seconds. It took me quite a while to account for this phenomenon, but I finally arrived at the conclusion that I had reduced the area available for heat transference from the pistons. Thus the pistons were now running considerably hotter than the cylinder walls, thus maintaining a better seal *so long as this temperature difference existed*! So it would appear that my pistons were previously overcooled.

Some time later, I was running the engine on a fairly protracted test, when my cooling fan stopped. I didn't notice this, but the engine did! She stopped, with expensive noises very much in evidence. Fearing the worst, I stripped down, but found nothing obviously amiss, until a closer inspection revealed that the liners had dropped, due to the differential expansion, and were fouling the rotary valve disc. They were encouraged back to their correct positions, and pinned to prevent a recurrence of the incident; at the same time I decided to check generally for wear. The mainshaft was worn about 0.001 in. at the side opposite the crankpin, but the big and little-ends showed no signs of wear. The pistons had lost 0.0001 in., and the bearing hole in the rotary valve was about 0.001 in. oval, due to its lack of balance.

I had been bearing in mind the differential expansion effect, and had evolved by this time a possible solution; at the same time I hoped to improve the gas flow into and out of the cylinder. I decided to remove the piston crowns, and replace them with pressed-in light alloy heads, domed to a height of $\frac{1}{8}$ in. The head was recessed to clear the domes, and the corners of the combustion chamber rounded off. On test, the engine gave 0.32 b.h.p. at 8,000 r.p.m., and compression was retained at all times and at all engine temperatures. I seemed to have hit on the solution first time.

Still searching for power, I turned my attention to the rotary valve, or, rather, its mating face; I cleared this as shown in Fig. 7 to a

depth of 0.010 in., and was rewarded with an extra 1,000 r.p.m. and a b.h.p. figure of 0.36. It seemed now that we were as far as we could get with the present design in the matter of reducing friction, and for a first design the results were highly satisfactory. However, I did not remain satisfied for long.

On the score of tractability, this proved to be my undoing. The engine would not run at low speed, and was very erratic at part throttle. At speeds below about 8,000 r.p.m. there was a terrific spray of blow-back from the carburettor; but on opening up, I got a really good result, the b.h.p. reading being 0.44 at 11,000 r.p.m.

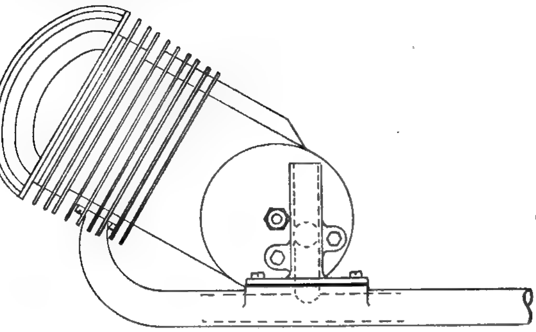


*Fig. 3. "Hot-spot" layout*

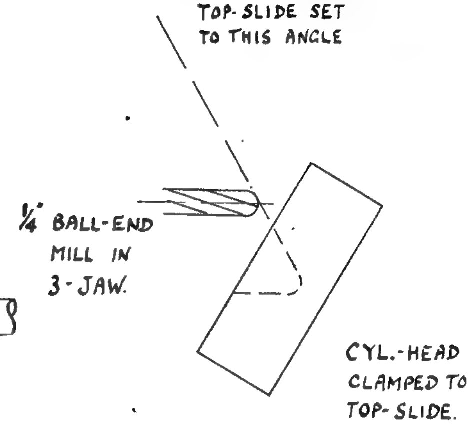



*Fig. 5*

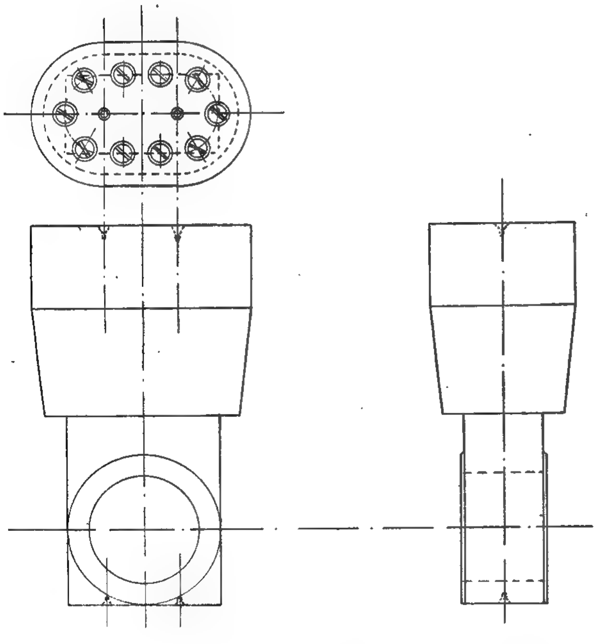


*Fig. 4. Blocks ready for finning*

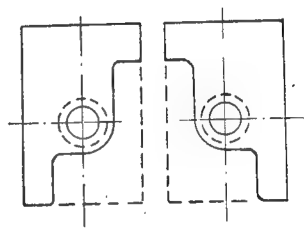


*Fig. 6. Cut-away of pistons*

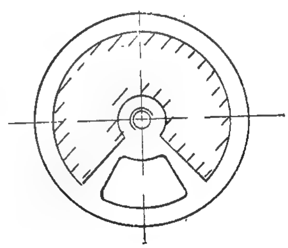
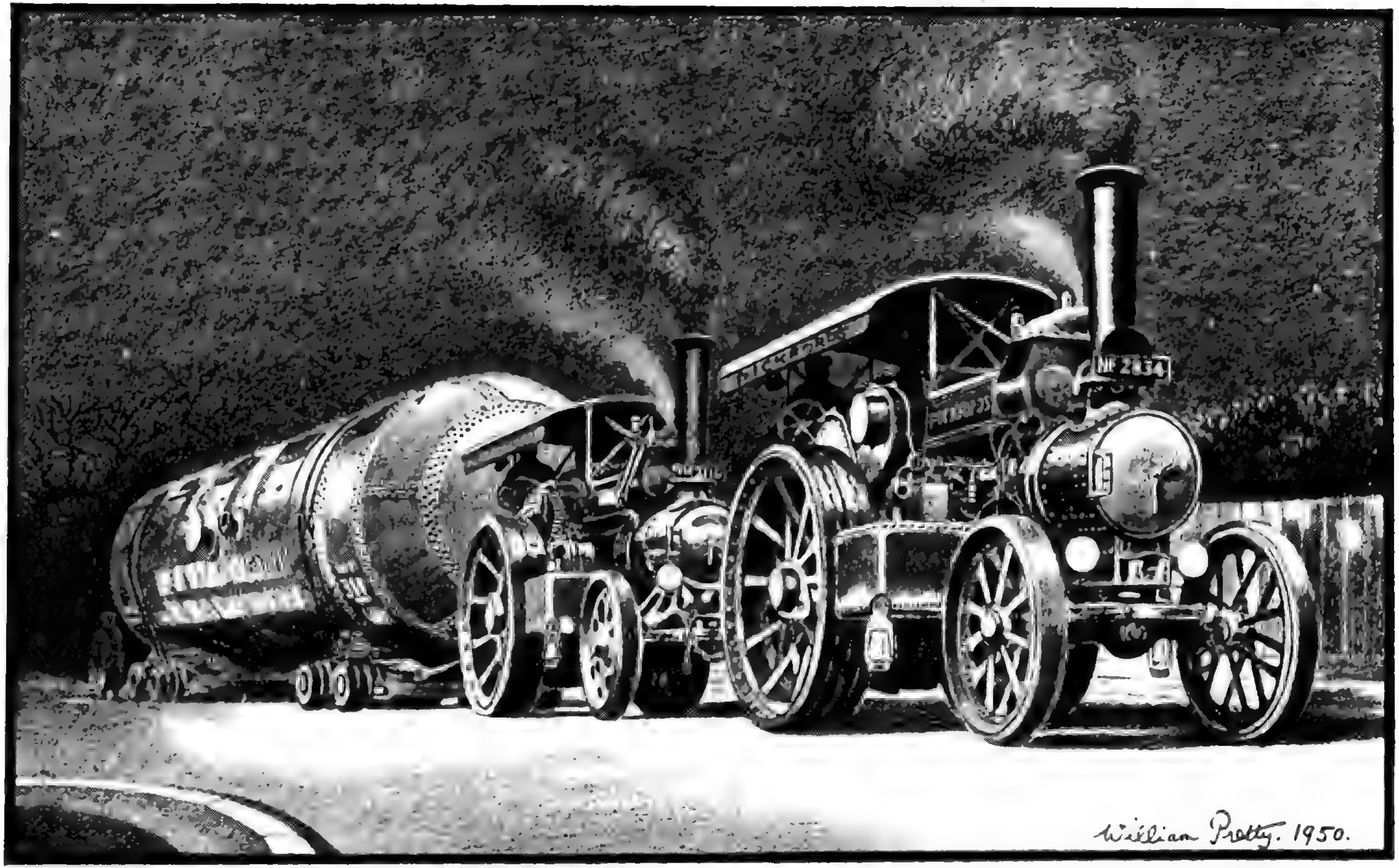


*Fig. 7. Clearance below rotary valve*

I soon started off on a new tack, inspired by the "megaphone" effect well known in motor-cycle racing practice. I made a new rotary valve, timed to open about 10 deg. after B.D.C., i.e. while the transfer and exhaust ports were still open. By this expedient I hoped to induce a flow of gases right through the engine, thus getting the induction process properly started quite early in the cycle.

On stripping down after several runs, I found that the little-ends of the con.-rod were blued from the heat to about ¼ in. down the rod. I was glad that I had used steel and not light alloy! The bearing surfaces were unimpaired, however, and the big-ends were in excellent condition. The main bearing had lost about another 0.001 in., but the pistons seemed the same as before.

(*Continued on page 762*)




*TRACTION ENGINES EN ROUTE.—The illustration reproduced above is from another of Mr. William Pretty's masterly pencil drawings; the original is based on a photograph published before the war, and depicts a steam accumulator being transported from Scotland to London, a journey of more than 300 miles. This astonishing procession consisted of the two traction engines, two sets of bogies and the accumulator, which, incidentally, was destined for Beckton Gasworks. The total length extended to 150 ft.; travel was possible only at night and at a speed of 2 m.p.h. A van containing fuel for the engines followed, and the final item in the ensemble was a caravan in which the crews slept during the daylight hours*

# Novices' Corner

## Lathe Boring Tools

If good results are to be obtained when using boring tools in the lathe, it is essential that the cutting edges should be correctly formed and the tool itself suitable for the particular work undertaken. The importance of this will be manifest when, for example, boring the bearings to carry a shaft so that a good finish is left on the work, for, if the tool is not right, a rough or uneven bearing surface may be formed.

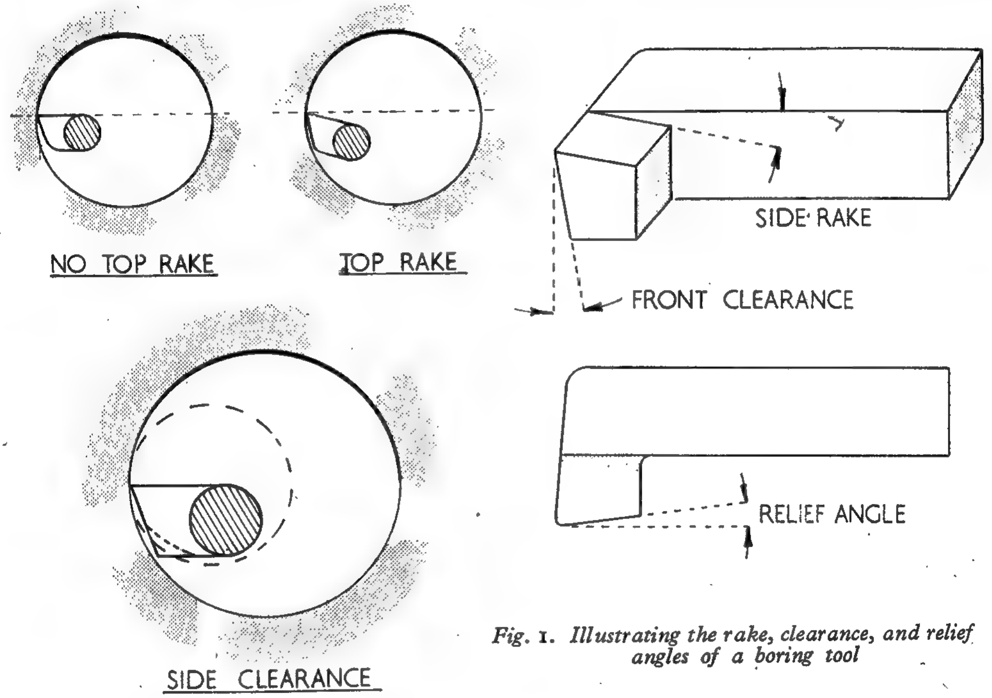



*Fig. 1. Illustrating the rake, clearance, and relief angles of a boring tool*

### The Cutting Edges

The characteristics of a boring tool are essentially similar to those of the other lathe tools; that is to say, proper clearance and rake angles must be given to the cutting edges. For cutting steel, the boring tool is usually given some top rake as depicted in Fig. 1; but what is, perhaps, more important to obtain free-cutting is that side rake should also be provided, as this affords a cutting edge sloping in the direction in which the tool cuts. If the side rake of a boring tool is compared with that of a knife tool, it will be apparent that the two are similar, except that one tool is cutting inside the work and the other on the outer surface.

Boring tools will also cut aluminium alloys more freely if given top and side rake, but for boring brass the rake should be much reduced, or even absent, as otherwise the tool is apt to dig into the work. Fig. 1 also shows that front clearance must be given to the tool to enable it to travel forwards along the line of cut without rubbing against the shoulder formed on the work as the tool advances. In the same way, side clearance is also necessary to keep the part of the tool below the cutting edge from rubbing on the side of the bore. It should be borne in mind that the amount of side clearance required will depend, in part, on the diameter of the bore being machined; for, as represented in Fig. 1, by the broken-lined circle, the heel of the tool will rub against the surface of a bore of small diameter unless the side clearance is increased accordingly.

An easy way of determining whether the side clearance is sufficient is to enter the tip of the boring tool in a hole in the drill gauge of the same diameter as the bore to be machined; the appearance will then be like that shown in Fig. 1 illustrating side clearance. As with the knife tool, chatter is apt to arise if too great a length of

the cutting edge is in contact with the work surface, and, although the tip of the tool may be rounded, the edge behind the tip should be ground obliquely in order to form a relief angle, as represented in the drawing.

Apart from the actual cutting edges, the shank of the tool should be made sufficiently rigid to keep it from springing under the stress of the cut; it follows, therefore, that where the shank is slender to permit of machining small bores, the cutting pressure on the tool point should be correspondingly reduced by making the tip more pointed. It may also be found an advantage to mount a slender boring tool a little above the lathe centre height, for, should the tool spring, it will then move away from the work surface, whereas a tool mounted below centre height will tend to be pressed more deeply into cut.

### Types of Boring Tools

When it was the custom to use lathe tools made of ordinary carbon-steel, boring tools, in common with others, were forged to shape and then finished by grinding; but with the introduction of the more expensive high-speed steels, money was saved by fitting a high-speed steel cutter-bit in a shank made of ordinary steel. Examples of forged boring tools are illustrated in Fig. 2, and it will be seen that they vary greatly in form according to the purpose for which they are intended. The more robust tools are designed for taking heavy cuts where the bore is large enough for them to enter; the slender tools, on the other hand, are used for boring small, deep holes and are capable of taking only light cuts. It will be noticed that the latter tools have their cutting edges correspondingly reduced in length in order to lessen the strain on the tool when cutting.

The Eclipse make of boring tool, illustrated in Fig. 3, has a flat formed on the under side to facilitate mounting the tool in the lathe toolpost.

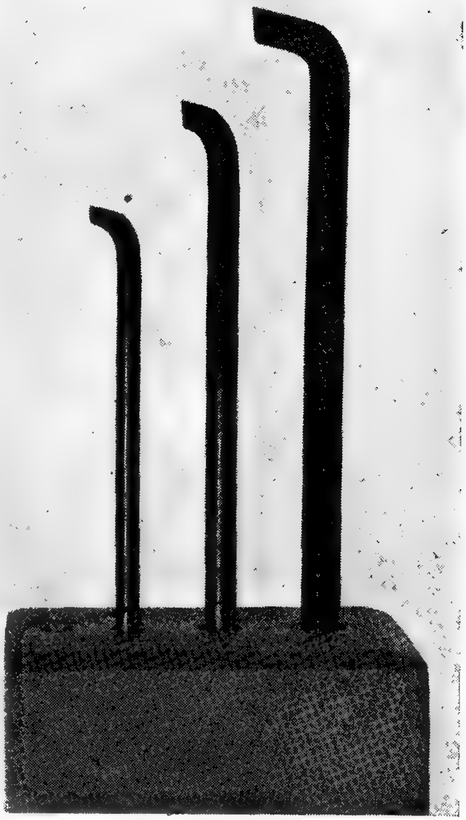


*Fig. 3. A range of Eclipse boring tools*

These tools are made with shank diameters ranging from $\frac{3}{16}$ in. to $\frac{3}{8}$ in. and they are particularly useful for machining long bores, but, when employed for this purpose, the overhang of the tool should be kept as short as possible in order to maintain rigidity. It will be found in some lathes that a plain boring tool, when mounted in the toolpost, cannot be brought near enough to the lathe centre-line to allow small holes to be bored; this difficulty is usually overcome by setting the top-slide at an angle, and then feeding it inwards to bring the tool into the required position. Another method of setting the tool towards the lathe centre-line is to mount the tool in a holder which projects from the toolpost. A tool of this type is shown in Fig. 4, and it will be evident that the necessary stand-out is readily obtained. This particular tool, acquired several years ago, is apparently of French manufacture and is supplied with tool-bits of three different sizes. A

*Fig. 2. A group of forged boring tools*

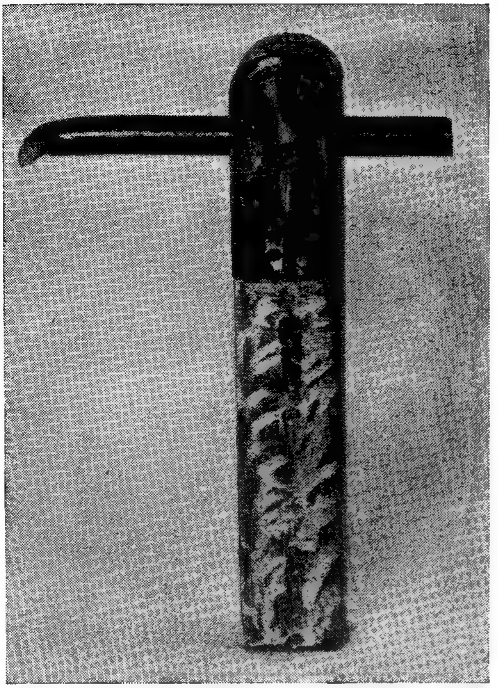


*Fig. 4. An extension holder fitted with a boring tool*

boring bar furnished with an inset cutter can be mounted in the lathe tool post when gripped in a split, square-section holder of the form illustrated in Fig. 5; but again, where the tool has to be mounted nearer to the lathe centre-line, a special holder of the form shown in Fig. 6 is required. This holder was made for mounting

The dimensions of the shank can be altered to suit any particular lathe, but those shown are suitable for mounting the tool in a 4-tool turret and using a packing strip $\frac{1}{8}$ in. thick to raise the tool point to centre height. The holder is made from a length of mild-steel bar 1 in. in width and $\frac{1}{2}$ in. in thickness.

The material is first formed to shape with the hacksaw and file or with the aid of a shaping machine. After the cross-centre-lines of the bore have been marked-out, the work is mounted in the toolpost and its height is adjusted to bring the horizontal centre-line of the head to exactly lathe centre height; the cross-slide is then set so that the vertical centre-line is on the centre-line of the lathe. These settings can easily be made by mounting a small centre drill in the mandrel chuck and then bringing the work centre opposite to the point of the drill. Next, lock the top-slide and the cross-slide.

Start the lathe and feed the work to the centre drill by traversing the saddle. The work centre so formed is used to guide a pilot drill which is put right through the T-head; this is followed by a drill a few thousandths of an inch smaller than the finished bore size to allow for reaming. The reaming is done by hand after the work has been removed from the lathe, and it is advisable to start the reamer at the back end of the bore, as any bell-mounting of the hole matters less at this end.

It should perhaps be explained, that, as indicated in Fig. 1, the centre-line of the boring bar lies $\frac{1}{16}$ in. below lathe centre height when the finished tool is mounted in the tool-post.

The reason for this is that the $\frac{1}{8}$ in. diameter cutter-bit passes through the centre of the boring bar, and its cutting edge lies therefore some $\frac{1}{16}$ in. above this centre-line. This means that, when machining the bore to carry the bar, the tool itself must be packed up $\frac{1}{16}$ in. above its final working height.

It will be clear that the height of the tool point when in use can be adjusted by rotating the bar in its holder, but, as represented in Fig. 1, this

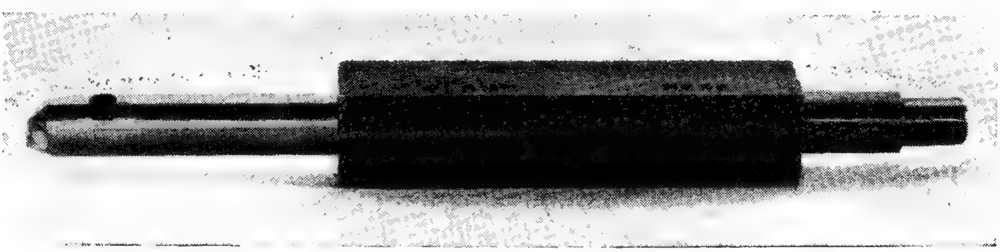


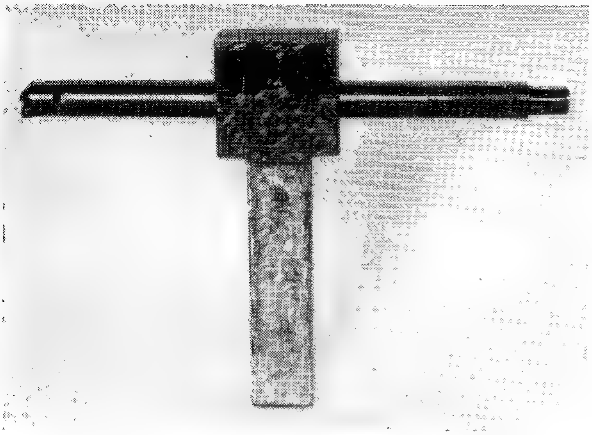
*Fig. 5. The Nulok boring bar in its holder*

a $\frac{5}{16}$ in. diameter Nulok boring bar in a Drummond lathe, and, as it has been found so serviceable during many years of use, a description of its construction may be helpful to others.

In the photograph, and in the working drawings given in Fig. 7, it will be seen that the holder is made T-headed and is furnished with two clamping screws to give greater security and keep the boring bar from tipping downwards when cutting.

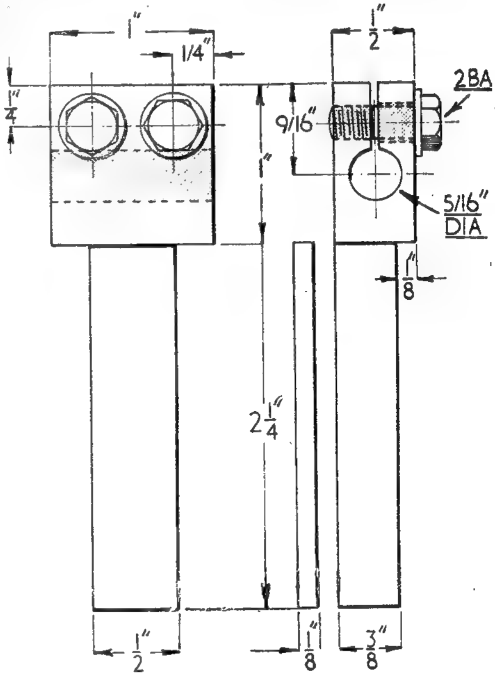
will at the same time alter the angle of top rake.

To get back to the constructional work, the holes for the two 2-B.A. hexagon-headed clamping screws are now drilled and tapped, but, before being tapped, these holes are enlarged to a few thousandths of an inch over the clearing size as far as the centre-line of the head. To allow the holder to close on the boring bar and grip it firmly, a slit is made with a slitting saw



*Left—Fig. 6. A T-headed holder to carry a boring bar*

*Below—Fig. 7. Showing the dimensions of the T-headed tool holder and its packing strip*




into the bore. Although the slitting can be done with a small, hand hacksaw, a much neater job will result if this is carried out with a circular slitting saw mounted on an arbor carried between the lathe centres ; for this purpose, the holder is gripped in the lathe toolpost and the head is set to lie vertically.

As has previously been pointed out, the saw is apt to grab as it cuts across the drilled holes, and this is prevented by tightening the cross-slide locking-screws until the feed handle becomes rather stiff to turn. To complete the holder, it only remains to fit the clamping-screws and to give the work a good finish all over with a fine file.

In conclusion, it may be as well to point out that the shank of the tool depicted in Fig. 4 has been badly damaged by the points of the clamping-screws fitted to the tool turret. When a tool has been treated in this way, not only is its appearance marred, but, more important still there will then be difficulty in setting the tool exactly as required, for the tips of the clamping-screws, by engaging in the pressure marks, will tend to take charge and determine the position of the tool. This needless damage to tools should be avoided at all costs, and it will not occur if a strip of sheet brass or copper is placed between the upper surface of the soft steel shank and the tips of the hardened clamping-screws.

# A Split-Single Two-Stroke

(*Continued from page* 757)

In view of the heat generated, and the vibration due to bad engine balance, it was decided that the unit was unfit for further development. Incidentally the fuel used throughout these tests was Pool petrol and Castrol XL in the proportions of 8 to 1.

A later test with a "very potent medicine," just gave me time to establish a reading of 0.52 b.h.p. at 15,000, before the engine stopped with the exhaust piston crown softened by the heat and *blown in*.

Just now I have no facilities for practical work, but I am not exactly wasting my time. I am designing, among other things, a fearsome array of testing equipment, a larger watercooled engine, and an induction layout in which the inlet opening and closing points can be varied over a wide range while the engine is running ; I am also investigating the possibilities of pumping fuel through an injection nozzle into the *cylinder* after scavenging with air only. This is quite an interesting proposition, as it involves metering of the fuel, with a maximum quantity of the order of 1 cu. mm. for a 10 c.c. engine ; as soon as I have room to install a lathe again, I shall follow up this fascinating field of development.

# Improvements and Innovations

## No 12—Trucks

### by "1121"

THE three passenger trucks belonging to the Society of Model and Experimental Engineers will, in some ways, be as well known as the engine No. 1928, although, from another point of view, any passenger trucks are likely to receive less publicity and attention than the locomotive pulling them. Ours, however, are sufficiently well known to have prompted several people to write and ask for particulars of them, so that they may be used as a pattern for new ones being built. It is hardly possible for any member of the S.M.E.E. track gang to produce a full description, with working drawings, every time information is asked for, and so we had the idea that a few details would not be out of place in this series, in case there may be others who are looking round for a design for a reliable and easily-made truck. It is our opinion that these trucks are as near perfect as can be, and anyone who cares to try to estimate the amount of work they have done in the 18 or so years of their existence is welcome to do so, and we think the result, whatever it may be, will be a pretty good indication of their reliability, soundness of design, and ability to stand up to hard work and rough usage. *We* try to take care of the trucks but unfortunately some other people who sometimes borrow them are not quite so particular. On certain occasions in the past, the trucks have come back looking as though they had been used as battering-rams for smashing open strong-room doors.

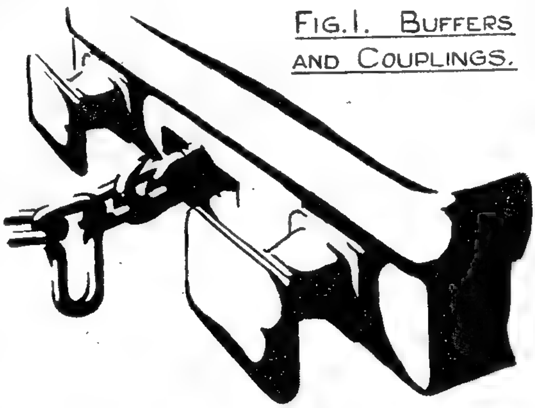


Fig. 1. Buffers and Couplings.

Before giving details of construction, we will give a general specification.

The trucks are 3 ft. 4 in. long over headstocks, and $9\frac{1}{2}$ in. wide, and are carried on two 5-in. gauge bogies, with wheels $3\frac{1}{4}$ in. dia. The bogies are pivoted 2 ft. apart, and have a wheelbase of 8 in. They have plain flat wooden tops, $\frac{3}{4}$ in. thick, attached to the underframes with $\frac{3}{16}$-in. coach bolts. All wheels are braked, and the brakes on any truck can be applied from either end. The brakes on all three trucks can be actuated from the driver's end by the attachment of a simple cable coupling device, in conjunction with small clamps fitted on the truck couplings, to keep them rigid. The trucks run on ball-bearings, and are fully sprung. Large rectangular spring buffers are fitted, and three-link couplings, the centre link of which is of the G.W.R. type for close-coupling (Fig. 1). Extensive use is

Fig. 2. Underframe Construction.

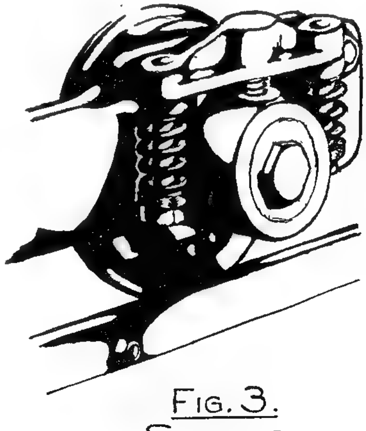


Fig. 3. Axlebox Springs.

made of castings in the construction of the trucks, together with four longitudinal members of steel angle, two on the outside being 1 in. × 1 in., and two between them of ¾ in. × ¾ in. The outer angles are attached to the ends of the buffer-beam castings, and the inner angles are located in slots (Fig. 2). There are altogether nine different castings used, and these are as follows :—

Buffer-beam (2 off, gunmetal) ; Bogie side frame (4 off, gunmetal) ; Bogie stretcher (2 off, gunmetal) ; Axlebox (8 off, gunmetal) ; Axlebox plug (8 off, gunmetal) ; Spring bar (8 off, gunmetal) ; Brake lever socket (2 off, gunmetal) ; Brake shoe (8 off, gunmetal, cast in a ring) ; Wheel (8 off, cast-iron).

It will be observed that all these castings, with the exception of the wheels, are of gunmetal, the idea being that this material will bend rather than break. This has saved the day on several occasions, when the trucks have returned home with their bogie frames tied up in knots. How do they do it ? Ask us another !

The ball-bearings are of the self-aligning type, and are situated towards the *outer* end of the axlebox, that is to say outside the bogie side frame. The slot in the frame thus need only be wide enough to accommodate the part of the box through which is a clearing hole for the axle. This means that the support for the axle is not close up to the wheel, but out at the end of the axle, but whatever else has befallen these trucks in their long life we have never yet found a bent axle, so it does not seem to be worth considering this as an objection. This design has the advantage that the weight is taken by the springs immediately over the ball-bearings, so that there is no tendency to tilt the axlebox over in the guides.

The springing arrangement is worth mentioning—double springs being used, a light coil spring housed in blind holes in the top of the axlebox and the underside of the spring-bar on which spring the truck rides when empty. When a load is applied, this spring is compressed until the spring-bar comes down solid on top of the axlebox, and the main springs then come into action. These bear underneath lugs cast on the bogie side frame, through which pass studs fixed in the ends of the spring-bar. On the lower ends of these studs are adjustable nuts and lock-nuts (Fig. 3). By this system the truck is always correctly sprung, whether empty or loaded. In addition to this springing, the bogie bolsters contain blocks of rubber about 1 in. thick, on which the top of the truck rests, allowing the bolsters a certain amount of sideways cant, and softening the riding of the truck (Fig. 4).

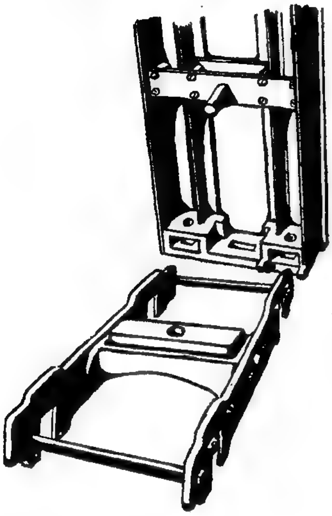


Fig. 4. Bogie Mounting.

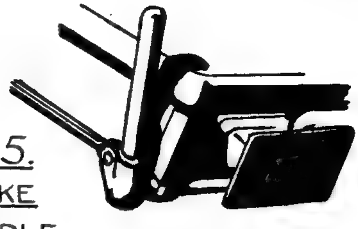


Fig. 5. Brake Handle.

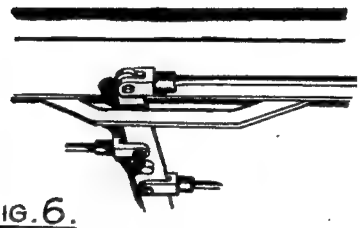


Fig. 6. Brake Cross-lever.

The brakes are operated by pull-rods, passing from the lever socket (Fig. 5) along the outside of the truck frame to the outer extremity of a cross-lever in the middle. Nearer the central pivot of this lever are attached the rods passing to each bogie (Fig. 6). These rods are of motor-cycle spoke about 5/32 in. dia., and are set to clear the inner axles. This set introduces a certain amount of " springiness " into the gear, and while the rod will not straighten out in normal use, the amount of set can be altered with pliers for the purpose of adjusting the gear. The brake blocks on the outer pairs of wheels are operated by a compensating arm on the inner cross-bar (Fig. 7).

The Model Railway Club has recently had three trucks built to the same general design as those of the S.M.E.E., but with certain differences to the brake gear. These modifications provide " continuous " braking on all trucks without any cables or other connections being

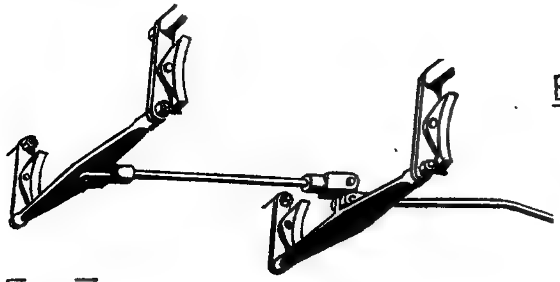


Fig. 7.
Brake Compensating Gear.

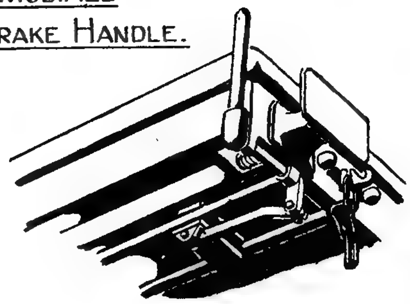


Fig. 8.
Modified Brake Handle.

necessary—when a truck is coupled on behind the driving truck it has its brake applied automatically by the driver's handle.

The set consists of two driving trucks, having orthodox buffers and three-link coupling at the driving end only, so that an engine can be coupled on to either end of the train, and a "trailer" truck which is coupled between them when wanted. This truck has brakes operable from either driving truck, but no handle of its own. The two couplings between the three trucks consist of a plain drawbar, such as is used to couple a tender to an engine, with a pin through a hole at each end. In this case, however, the drawbar pins are not removable, being actually spring plungers, which are pulled downwards to release the drawbar. To "park" a drawbar for storage, so that it shall not project and get damaged if the truck is stood up on end, it is only necessary to release it and push it inwards until the plunger engages with the outer hole.

Running the whole length of each truck are two "push-rods," which are moved backwards from the driving end when the handle is operated (Fig. 8). At the rear end of these rods (and at both ends in the case of the centre "trailer" truck) is a buffing-plate, which, when it is thus caused to move outwards from the headstock, presses inwards the similar buffing-plate on the truck behind. In the centre of the buffing-plate is a slot through which passes the drawbar (Fig. 9). In this way movement of the driver's lever causes the "push-rods" on all three trucks to move backward through the train.

These rods are arranged to operate the brakes on each truck by means of a flat "V"-cam, clamped to the rods near the middle of their length, which moves a "T"-lever taking the place of the plain cross-lever on the old trucks (Fig. 10). It will be seen that whichever way the "push-rods" move, according to which driving truck is being used, the "T"-lever always moves in the same direction. This lever is rodded to the bogies in the same way as in the original design, and to reduce resistance it is fitted with a ball-race against which the cam face operates. The sideways thrust on the cam is taken by another ball-race running against the adjacent framing angle. By this means the gear works very easily, and the single coil spring attached to the end of the "T"-lever is sufficient to return the "push-rods" to their central position.

We hope that these few notes and sketches may be of some help in supplying preliminary ideas for anyone thinking of building trucks of a similar type.

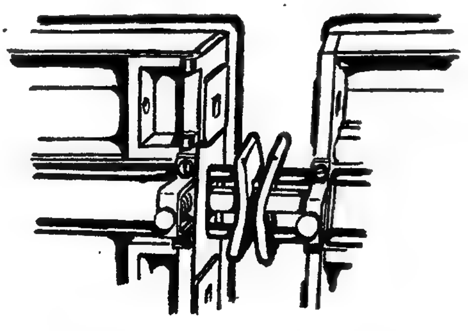


Fig. 9. Brake Buffing-plates and Rigid Coupling.

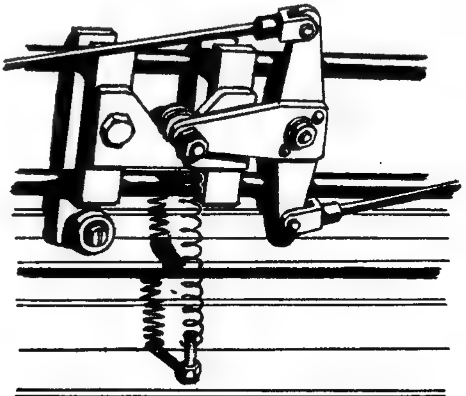


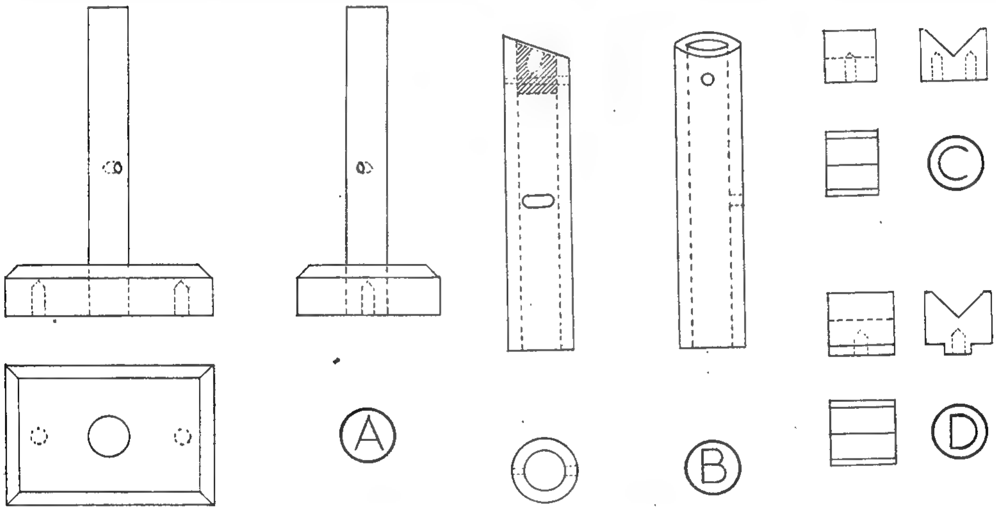
Fig. 10. Brake Cam Gear.

# SMALL DRILL GRINDING

## by Keith Campbell

IN a previous issue, the editor invited anyone to send in details of a twist drill sharpener which actually works. I feel there must be a catch somewhere, but all the same I'll buy it. All I can say is that the appliance—to call it a jig sounds presumptuous—I am going to describe sharpens my own drills to my entire satisfaction.

I should make it quite plain that it is not the result of deep reasoning, conics and the drawing board. It began quite suddenly after I had come on the editor's words again the other day and crystallised into action when I found a short length of thick-wall brass tube. After that it was a matter of trial and error.




Another point is that while the appliance will present the drill to the wheel at the right angle, you have to do the work yourself in order to get the backing-off. On the other hand, this backing off will be uniform and more or less correct.

Now to business. The elevation and plan should give a reasonable idea of what the thing looks like, and its relation to the wheel. I will deal with the exact positioning later on. In brief, it is no more than a flat arm mounted obliquely on a sleeve which, in turn, is slipped over a pillar attached to the base. On the arm are mounted two small vee-rests which support the drill. My own grindstone is a fudged-up affair on a wooden baseboard, which explains why the appliance is shown so mounted.

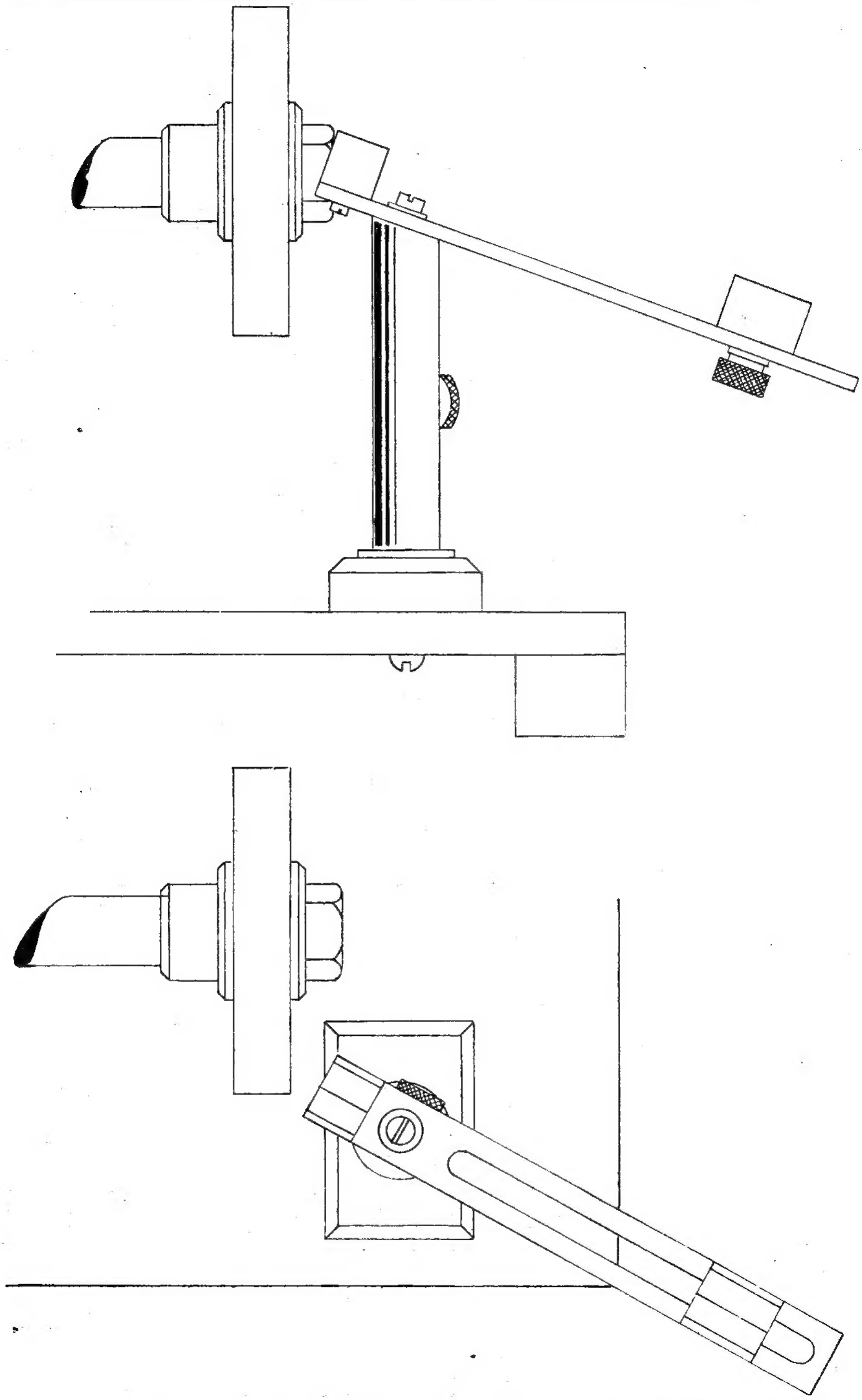
Take the base and pillar (*A*) first. The base is any chunk of mild-steel thick enough to give a firm grip to the pillar. As the inside diameter of the brass tube was $\frac{3}{8}$ in., I used a short length of $\frac{3}{8}$ in. mild-steel rod for the pillar, making it a force fit into the base. The drawings are not dimensioned, as these will vary with individual wheels. The design of the base, too, is purely a matter of choice.

Next, the sleeve and the flat arm. These are shown at (*B*) and (*E*). As for dimensions, here the requirement is that the sleeve must be of a length such that when slipped over the pillar—with a fibre washer between it and the base—the angled top will allow the flat arm (*E*) to lie in a relation to the wheel similar to that shown in the elevation. The simplest plan would be to work on an overlength sleeve and trim it down exactly later on.

The first job on the sleeve is to file the top edges down to an angle of seventy degrees, as indicated at (*J*). Having got a nice flat surface there, find a stub end of $\frac{3}{8}$ in. rod—brass, mild-steel or what will you—and insert it just far enough into the top of the sleeve for you to be able to drill through for a taper pin, at the same time leaving enough space above the pin hole for drilling and tapping a short 4-B.A. hole.

Having drilled the hole, shove a parallel pin through to hold the stub in place, and, using the top of the sleeve as a guide, scribe the angle already formed on to the stub. Withdraw the pin, take out the stub and cut it down to the required angle. Having done that, scribe a line all round, about 1/32 in. below this angled surface and file down to it. The general idea of the stub is shown at (*H*), and the first drawing at (*B*) shows it back in the sleeve. However, that is jumping the gun.

Now drill and tap the 4-B.A. hole in the top of the stub, then reinsert the stub into the sleeve, line up the holes and get busy with a taper broach. Knock in a taper pin, cut off the ends and clean up. The stub should now be firmly held in the



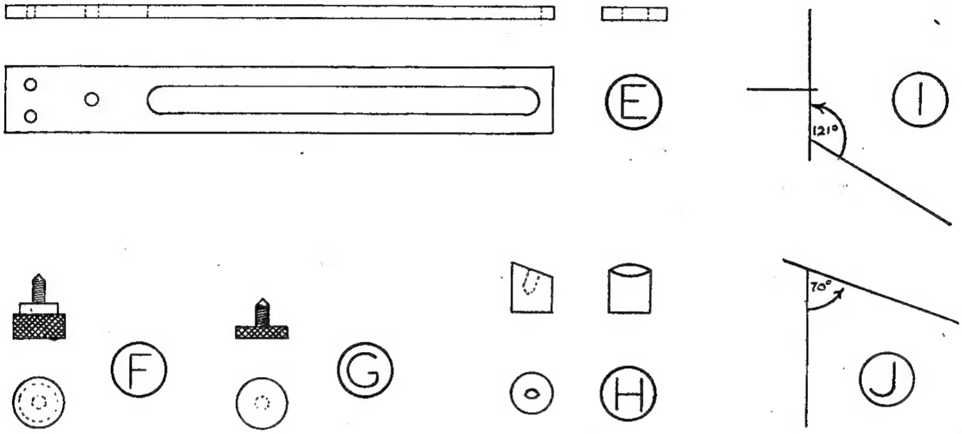
*Elevation and plan of the appliance for grinding small drills*

sleeve with the angled surface lying just below that of the sleeve. See (*B*).

The flat arm (*E*), I made out of $\frac{1}{8}$-in. brass, drilling the ends of the $\frac{1}{4}$-in. slot and cutting out the rest with a piercing saw. The location of the three holes up forrard is not critical. The front pair are for holding the front vee-rest and the single one is a 4-B.A. clearing hole. The only stipulation is that, for reasons of rigidity, this single hole should be as far forward as the front vee-rest will allow.

wheel—as shown in (*I*), the front of the forward vee-rest is a good $\frac{1}{8}$ in. clear of the wheel.

Next, with protractor and bevel-square, set the arm to the exact angle shown in (*I*) relative to the side of the wheel, holding the base firmly against the clamped straight-edge. When the angle is achieved, tighten down the set-screw (*G*) really hard, so that the coned tip will bite into the pillar. Now put the largest drill liable to be sharpened on the vee-rests, advance the cutting edge towards the side of the wheel, with this edge




The vee-rests themselves—(*C*) and (*D*)—are filed up out of anything handy. The rear rest (*D*) is provided with a tang $\frac{1}{4}$ in. wide and lined up with the vee which rides in the slot. The tang is made 3/32 in. deep, so that the rest can be secured from underneath by the thumb-screw (*F*).

When the front vee rest has been fitted to the arm, this latter is screwed down to the top of the sleeve, as shown in the elevation. The 1/32 in. filed off the stub gives just enough clearance for the 4-B.A. screw to get a good hearty pull down and hold the arm absolutely secure against the angled face on top of the sleeve.

Now mount the sleeve on the pillar and test the whole thing for height. This is not critical within reasonable limits, as long as the edge of the drill comes up against the side of the wheel slightly above the latter's centre-line. The elevation gives an idea of the position. Cut down the bottom end of the sleeve till this height is achieved.

We now come to the exact positioning of the appliance. To do this, first drill a small hole in the side of the sleeve where it will later be easily accessible to your right hand. This hole should be the tapping size for the set-screw (*G*). Tap it accordingly, and then grind down the tip of the set-screw (*G*) to a truly centred conical point.

Now clamp a straight-edge over the base-board in such a position that it is parallel with the side face of the wheel and so that when the left-side of the base is held against it, with the arm in approximately the relative angle to the side of the

exactly horizontal, and move the base either in or out until the cutting edge of the drill lies as near the outside edge of the wheel as possible. Now mark off exactly the position of the base on the base-board.

Next, loosen the set-screw, remove the sleeve and look at the pillar. If you tightened up the screw good and hard, there should be a dimple where the coned point bit in. Centre punch this, drill and tap to suit the set-screw (*G*). Open out the tapped hole in the sleeve to an exact clearance for the same screw. The sleeve can now be removed from the pillar at will and re-located exactly.

In the drawing at (*B*), this clearance hole in the sleeve is shown as a slot. This is no more than an extension of the hole in an anti-clockwise direction to allow the grinding of more acute angles for special purposes. At the same time it retains the exact locating face for the normal hundred and eighteen degrees.

The next job is to mount the base and pillar securely on the baseboard. This is a matter of individual preference, screws from the top being just as good as the way shown. The important thing is to get it back to the exact position already marked. Replace the sleeve, put in the set-screw, hold the arm so that the locating face of the hole is against the screw and tighten up. The thing is now ready for grinding.

Adjust the rear vee-rest to suit the length of drill, then, with the wheel turning, advance the drill towards the side face, holding the former between the thumb and forefinger of the right hand. The forefinger of the left hand presses

down on the drill on the front vee-rest to stop it riding up as it is turned. The cutting edge should be set exactly horizontal.

As soon as the edge meets the wheel a slight clockwise turn should be given with the right hand—far enough to grind the backing-off, but not so far as to catch the other cutting edge. This may sound difficult, but a little practice soon puts it right. Repeat this move as necessary, then turn the drill through a hundred and eighty degrees and start again on the other edge.

The equality of faces must be judged by eye, but this has not proved to be particularly difficult, and holes cut by drills I have ground seem to be very well to size.

I make no claim either for originality as regards this appliance nor that it will grind drills to the exact angles required in production. What it has done for me is to put a lot of old drills into good cutting order in a workshop where reasonable, but not excessively fine, limits are the order of the day.

# Queries and Replies

*Enquiries from readers, either on technical matters connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by stamped, addressed envelope, and addressed: "Queries Dept." THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.*

*Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.*

*More involved technical queries, requiring special investigation or research, will be dealt with according to their general intere t to readers, possibly by a short explanatory article in an early issue. In some cases the letters may be published, inviting the assistance of other readers.*

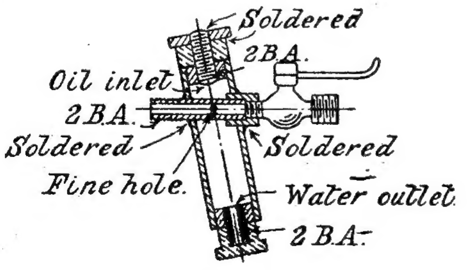
*Where the technical information required involves the services of an outside specialist or consultant, a fee may be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.*

*Only one general subject can be dealt with in a single query; but subdivision of details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered within the scope of this service.*

## No. 9815.—Operation of the Diplacement Lubricator
**J.H.C. (Bromley)**

**Q.**—I am at a loss to understand the principle and operation of the simple displacement lubricator. Perhaps you could explain, also give me approximate jet size and other dimensions of one suitable to feed a pair of cylinders $1\frac{3}{16}$ in. bore × $1\frac{1}{2}$ in. stroke. The engine is slow in revs. and the steam not superheated.

**R.**—The simple displacement or hydrostatic lubricator consists simply of a closed vessel which is fitted in the steam pipeline or in communication with the steam chest of a steam engine. It does not require a jet to control the rate of oil feed, which is determined by the rate




at which steam condenses in passing through the vessel, and, therefore, is self-governing to some extent, according to the amount of steam consumed. The steam condenses to water and, being heavier than the oil in the vessel, sinks to the bottom, displacing an equivalent amount of oil, which is carried by the steam into the engine. It is, of course, necessary to fit a plug for filling the lubricator, and a drain plug for emptying out the water. Both of these must be capable of being sealed when the lubricator is in use.

## No. 9853.—Synchronome Contacts
**S.J.N. (Birmingham)**

**Q.**—I have just completed a synchronome master clock and one slave dial, and should very much like your advice as to how I can stop sparking across the points.

**R.**—There should not be much trouble with sparking contacts in a synchronome master clock. You do not state whether this clock was one made by the Synchronome Co. or a home-made version of the design. In the latter case, there is a possibility that wrong materials may have been used for the contacts, or that the wrong voltage of supply has been used. In some cases, clocks of this type are energised from the mains, either through a resistance in the case of d.c., or a transformer and rectifier in the case of a.c. Under these circumstances, there is a possibility that sparking may occur at the contacts, and the only way to eliminate it is by the use of highly refractory materials, and just sufficient voltage for operating the clock reliably and no more. A condenser may be used across the contacts to suppress the spark in cases where battery supply is used, but some experiment in the capacity of the condenser is usually necessary in order to obtain the best results. The material used for the contacts should be a highly refractory metal, preferably platinum or platinum-iridium alloy, but silver or silver-gold alloy contacts also give fairly good results.

## No. 9846.—Drilling Speeds, etc.
## T.P.B. (Bradford)

**Q.**—I would be very pleased if you could give me the recommended r.p.m. at which drills should run for drilling $\frac{3}{4}$-in. and $\frac{1}{8}$-in. brass strip on a horizontal drill. The sizes used will be 18-, 19- and 20-s.w.g. I also intend to use a grinding wheel and cutting saw (running on the same head) for grinding the corners and cutting the brass into strips, as well as a polishing belt, and would appreciate the recommended r.p.m. for these.

**R.**—You do not state whether you are using high-speed or carbon-steel drills, but we presume that the latter will be used if a large amount of drilling is to be done, as the drills will last longer and cut faster. In this case, drills of the size mentioned will run quite efficiently at a speed of about 3,000 r.p.m. The speed of a grinding wheel or saw will depend on its diameter and also on the grade of the wheel or the quality of steel in the saw. We suggest that a 6-in. grinding wheel running at about 2,500 r.p.m. will be suitable, and a saw of similar size may be run at about 150 r.p.m. for working on brass. The speed of the sanding belt will depend on the diameter of the pulleys over which it runs, but assuming the use of pulleys about 4 in. diameter, it is common to run these at about 1,500 r.p.m. We may mention that the speeds quoted in all cases are subject to considerable variation, according to the class of work being handled, and also the type of material to be used, that is to say, abrasive or steel, and the safest way is to approach the makers of the particular materials.

## No. 9847.—Sensitive Pump Valves
## J.C.S. (Croxley Green)

**Q.**—I am working on a model of the pump type. It is very important that the valves, which are 3/32 in. diameter, should be very sensitive and act on the slightest movement of the ram. The stroke of the ram varies from 1/32 in. to 2 in. and is intermittent, pressure atmospheric. Would you be good enough to indicate the best type of valve for this purpose?

**R.**—There is no type of pump valve available which can be definitely guaranteed to respond immediately to the motion of the plunger, unless it is mechanically operated. In most types of pumps, it is extremely difficult to eliminate the possibility that a certain amount of air may be trapped in the pump, and this is liable to delay the valve action; also, the inertia of the valve will have a similar effect. Ball valves are quite satisfactory in the great majority of pumps, and we think that you might find it so in the particular case you mention. It would, however, be possible to lighten the valve and improve promptness of action by using a small mushroom or wing-type valve, or a disc valve. Any of these types will be much lighter in weight, in proportion to the size of port which they control, than a ball valve. Spring loading will improve the prompt closing of a valve, but it may tend to delay the opening of the valve to some extent, and we do not think that in this case it is desirable.

## No. 9848.—The "M.E." Hydroplane
## N.G.C. (Lowestoft)

**Q.**—I have made the "M.E." hydroplane hull and am very pleased with the result. I would appreciate your advice as to whether it is possible to fit a surface-type propeller to this hull as in modern practice, and if so, what size and pitch. The hull will be powered by a "Yulon 29" 5-c.c. g.p. engine. Would you tell me how to determine the position of the engine in the hull? Finally, can you tell me the approximate weight of the finished painted hull, less engine, shaft, propeller, etc.?

**R.**—The "M.E." 24 in. hydroplane hull was not originally designed to use a surface propeller, but it would be quite satisfactory for use with this type, if some modification was made to the lifting surfaces and planing angles. In view of the fact that this always is an experimental matter on which there are no reliable rules of design, we cannot advise you just what these alterations should consist of, but we suggest that it might be desirable to add false planes, under the forward part of the hull, so as to increase the planing angles to at least twice what they are at present. In the original design of the hull, the centre of gravity of the complete boat should be about 1 in. to $1\frac{1}{2}$ in. aft of the step, and this weight disposition should be approximately correct also for surface propulsion, unless the lateral position of the planes is altered. Most modern boats have either the step or the false planes farther forward than was usual with the submerged propeller. The weight of the hull, built according to the original design, should be approximately 14 oz., less fittings.

## No. 9849.—Testing Boilers
## C.G.R. (N.5.)

**Q.**—I have nearly completed a small marine type boiler and wish to have it tested to 120 lb. per sq. in. Will you kindly let me know the name and address of someone who could undertake this work?

**R.**—It should not be at all difficult to test your boiler yourself, as all that it needs is a small force pump and a reliable pressure gauge. The boiler should first be filled with water, either through the feed clack or any other convenient opening which can afterwards be sealed off, and only a few strokes of the pump should then be necessary to raise 120 lb. pressure. Another method of boiler testing, which needs only the pressure gauge and dispenses with the need for a pump, is to fill it completely as before, attach a pressure gauge and apply heat to the boiler, when the expansion of the water will provide the necessary pressure. In any form of hydraulic pressure testing, the boiler should always be completely filled with water, with no air or steam space. In this way complete safety is assured, as the boiler could not possibly explode or burst under these conditions. The only effect of failure or leakage would be a sudden drop of pressure. If, however, you wish to get someone to undertake the work of testing, we suggest that you apply to the Society of Model and Experimental Engineers, who have equipment for this purpose.